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See p. 221 for this week's announcement.
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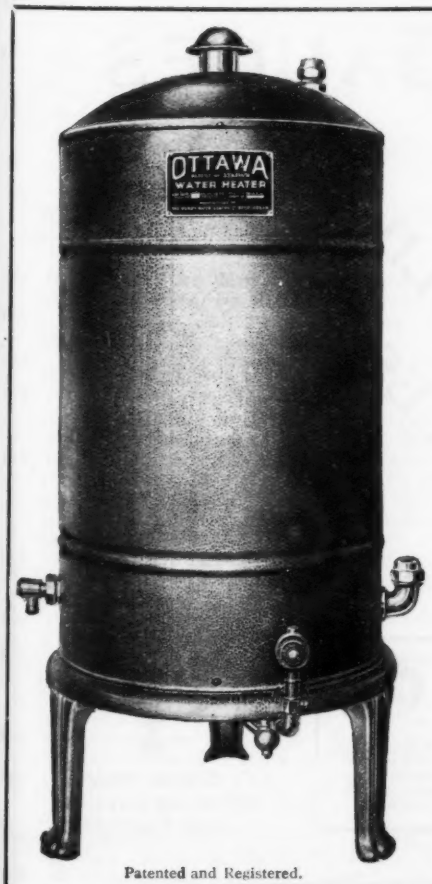

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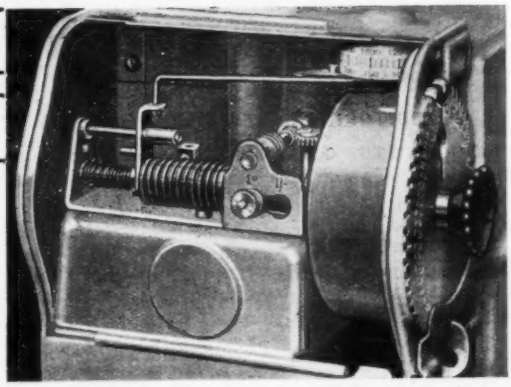

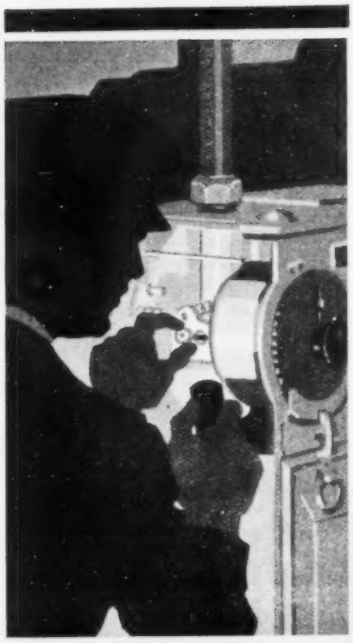

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THE GAS JOURNAL

JANUARY 25, 1933

Vol. 201. 85th Year No. 3636

A Glance at the Contents—

Extending Smethwick's Gas Service.

The Smethwick Gas Department has recently carried out a number of interesting contracts extending the application of gas on the district. [p. 196.]

Gas in the Wire Drawing Industry.

Experiences in Halifax of the utilization of gas in the wire drawing industry were outlined by Mr. J. Bradbury, of the Halifax Gas Department, in a paper read on Jan. 21 before the Yorkshire Junior Gas Association. [p. 199.]

Sales Methods in Newcastle.

The Newcastle-upon-Tyne and Gateshead Gas Company are nothing if not forceful and enterprising in their sales methods, and a novel scheme carried into effect during the period allowed for renewing motor licences is described on p. 194.

Rate Structure as a Business Builder.

"The determination of a proper charge for gas service is fundamentally the same as the setting of a selling price for a commodity or service in any other business."—Mr. A. J. Dobson in a paper before the Australian Gas Institute. [p. 208.]

Organic Compounds from Coke Oven Gas.

In a paper before the Institute of Fuel on Jan. 11, Messrs. J. W. Osterrieth and Georges Dechamps dealt with the subject of production of organic compounds from coke oven gas. [p. 202.]

Gas and South Wales' Industries.

Writing in the recent Trade and Industrial Supplement of the "South Wales Evening Post," Mr. W. H. Johns, Engineer and Manager of the Swansea Gas Light Company, drew attention to the part gas is able to play in the industries of South Wales. [p. 195.]

Gas Rates.

In view of the fact that this is the first time that the Australian Gas Institute has made the question of Gas Rates a subject for definite discussion, Mr. G. W. Woodbridge takes the opportunity of making a broad survey of the various matters involved. [p. 206.]

Lighting-up Verticals After Repairs.

A method of lighting up vertical retorts after repairs, which differs in some respects from the standard method usually adopted, was described to the Midland Junior Gas Association on Jan. 12, in a paper read by Mr. H. Smith, of the Nechells Works, Birmingham. [p. 211.]

Forthcoming Engagements

Jan. 28.—WALES AND MONMOUTHSHIRE JUNIORS.—Meeting at Neath. Paper by Mr. A. J. Howells.
Feb. 2.—MIDLAND JUNIOR ASSOCIATION.—Meeting. Address by Mr. H. Southern.
Feb. 4.—MANCHESTER DISTRICT JUNIOR ASSOCIATION.—Visit to Burnley Gas-Works. Paper by Mr. A. F. Rhead.
Feb. 4.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Meeting in Glasgow. Diploma Thesis by Mr. J. Webster and paper by Mr. N. C. Sturrock.
Feb. 13.—INSTITUTION OF GAS ENGINEERS.—Meetings of Finance Sub-Committee, 2 p.m.; Finance Committee, 2.30 p.m.; Executive Committee of the Council, 3 p.m.; Industrial Gas Committee, 4.30 p.m., 28, Grosvenor Gardens, S.W. 1.
Feb. 13.—MIDLAND ASSOCIATION.—Annual Dinner, Grand Hotel, Birmingham. Reception, 6.0 p.m.; Dinner, 6.30 p.m.
Feb. 14.—NATIONAL GAS COUNCIL.—Meeting of Central Executive Board, 28, Grosvenor Gardens, S.W. 1.
Feb. 14.—INSTITUTION OF GAS ENGINEERS.—Meetings of Council, 10 a.m.; Benevolent Fund Committee of Management, 12.15 p.m.; Education Executive Committee, 4 p.m., 28, Grosvenor Gardens, S.W. 1.
Feb. 14.—FEDERATION OF GAS EMPLOYERS.—Meeting of Central Committee, 28, Grosvenor Gardens, S.W. 1.
Feb. 15.—B.C.G.A.—Meeting of the Executive Committee at 12 noon in the Board Room, 28, Grosvenor Gardens, S.W. 1.
Feb. 17.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting. Paper by Mr. P. Richbell.
Feb. 18.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting at Bradford. Paper by Dr. F. J. Dent.
Feb. 21.—INSTITUTION OF GAS ENGINEERS.—Meeting of Gas Appliances Sub-Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.
Feb. 23.—JOINT JUNIOR ASSOCIATIONS.—Visit to B.I.F., Birmingham.
Feb. 24.—Official visit of Gas Salesmen's Circles to the British Industries Fair, Birmingham.
Feb. 28.—B.C.G.A.—Meeting of the General Committee at 3.0 p.m. in the Bradford Room, British Industries Fair, Castle Bromwich, Birmingham.
Feb. 28-March 2.—Joint Gas Conference at the B.I.F., Birmingham.
March 4.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Meeting at Glasgow. Address by Sir Francis Goodenough.
March 9.—MIDLAND JUNIOR ASSOCIATION.—Meeting. Paper by Mr. A. W. Attwood.
March 11.—WESTERN JUNIOR ASSOCIATION.—Meeting at Bath. Four short papers.
March 15.—B.C.G.A.—Meeting of Executive Committee, 12 noon, 28, Grosvenor Gardens, S.W. 1.
April 19.—B.C.G.A.—Meeting of Executive Committee, 12 noon, 28, Grosvenor Gardens, S.W. 1.

1933 "JOURNAL" Directory.

Page 92.—THURSO. D. D. Bruce, Manager, deceased.

EDITORIAL NOTES

The South Metropolitan Stock Issue Proposals

THERE was contained in last week's issue of the "JOURNAL" a summary of the main provisions of the few Gas Bills that are being promoted in Parliament this year, among them being that of the South Metropolitan Gas Company, whose proposals relate to the method of issuing stock. It is pointed out in the preamble to the Bill that the enactments relating to the Company require that all additional ordinary or preference stock shall be issued by public auction or tender, unless issued to the Company's consumers or employees, or in certain other special cases; but it has been found that this mode of issuing capital is not conducive to the raising of money on the most advantageous terms, and is accordingly inconsistent with the best interests of the consumers of gas and of the Company. It is therefore desirable that the requirements as to the issue of capital should be modified in the manner set out in the Bill.

That is to say, the Bill provides that all ordinary or preference stock issued by the Company in future may be disposed of at such price or prices and in such a manner as the Directors may determine to be most expedient for the purpose of realizing the best price obtainable. In the case of any such stock of the same class as any existing stock of the Company, the Company may, if they think fit, offer the same to all gas consumers and persons in the employ of the Company at, as near as may be, the average market price of such existing stock in the period of two weeks immediately preceding such offer, provided that in no case shall the price at which such stock shall be offered be lower than 5% below such market price. These provisions are not to apply to stock issued for the purposes of any co-partnership scheme of the Company, or in compliance with any agreement made under the Company's Acts of 1925 and 1932, or in redemption of or in substitution for redeemable preference stock. A further clause empowers the Company to pay a commission not exceeding 5% for underwriting such stock, provided the amount or rate of such commission are included in the prospectus.

The Bill has been considered by the Parliamentary Committee of the London County Council, whose report upon it was prepared for presentation at the meeting of the Council yesterday. In this report, the Parliamentary Committee point out that the provisions of the Bill would relieve the Company from the requirements of the "auction clauses," which have for over 50 years been included in Gas Companies' Acts providing for increases of capital. It is added that a somewhat similar proposal was contained in the Commercial Gas Bill of last session in respect of certain issues of stock by that Company. The Council, however, raised no objection to the proposal, which was subject to certain restrictions. With regard to the present Bill, the Parliamentary Committee say that they have arranged with the South Metropolitan Gas Company for certain amendments to be made in their Bill requiring the approval of the Board of Trade to the price of the issue of stock offered by public subscription other than by auction or tender, and limiting the amount of the underwriting commission on the sale of new issues of stock and providing for an additional limited amount to be paid only with the consent of the Board of Trade.

An Important Step

IN their issue of yesterday's date, the "Financial Times" featured an interview with "an authority fully conversant with the subject of Gas Company Legislation," who emphasized to them the fact that the step taken by the South Metropolitan Gas Company is an important and welcome one. In the first place, he pointed out that the arrangements for issuing stock by auction and by tender necessitate very considerable delay, and a favourable market may be lost—a misfortune which has happened frequently in the past. Secondly, the large type of investor, such as insurance companies, is not unnaturally reluctant to bid for an issue in these circumstances, partly owing to the trouble involved, and partly owing to the fact that such investors do not know at all whether any stock will be issued to them. For example, an insurance company may apply for a very big slice of the stock, and, owing to heavy over-subscription, may receive but a very small amount—an experience which makes them disinclined to repeat the operation. Again, in the case of the small provincial companies the restrictive provisions of the Acts have the effect of limiting the buyers of stock to purely local investors; those to whom the stock is offered being drawn from a small area, and being not always particularly interested in this type of investment. Likewise an issue by tender is not always noticed by a large body of investors, and it is difficult to get in touch with those who are likely to want to invest in gas stocks. "For far too long," says this authority, "gas companies have been compelled to have recourse to cumbrous procedure to obtain additional capital, and the sweeping away of antiquated restrictions once and for all is most desirable."

It is made clear that there have been some exceptions to the method of raising capital by auction or tender, but where these exceptions have occurred the clauses have prescribed that the approval of the Board of Trade should be obtained before making any issue to the public by means of a prospectus. The Bill of the South Metropolitan Gas Company leaves it to the discretion of the Directors to fix the issue price and commission and method of issue, though, as has been remarked above, the London County Council have arranged with the Company that they shall obtain Board of Trade approval as to issue price and underwriting commission.

Clogging Private Enterprise

WE have devoted infinite pains and a great amount of space in the "JOURNAL" in support of the claims of the Gas Industry to a far larger method of freedom than has been permitted to it in the past, and we are unfeignedly glad to chronicle any advances that may be made in securing this. Hampering provisions devised in times that are past—we had almost said in a bygone age—to meet conditions which years back ceased to exist, have too long proved a drag on progress. And there have been other things, too, to fight against—for instance, there has been the withholding of gas from Council House tenants. Here some good progress has been made; the Council House tenant, as well as the Gas Industry, is being freed from his bonds. Following upon the case of Kettering, the Bills which are being promoted by the Gas Light and Coke Company and the Commercial Gas Company, as will have been seen from the last issue of the "JOURNAL," contain provisions to prevent the imposing by Housing Authorities of restrictions as to the form of light, heat, power, and energy to be used by tenants.

One would like to see private enterprise placed in every way upon a level footing with competitive publicly owned undertakings, and this can be done only by equal treatment in all respects. Going further afield, and taking conditions as we understand them to prevail in New Zealand, the exemption of municipal and State owned trading undertakings from taxation which has to be borne by companies unfairly places private enterprise at a disadvantage. The Gas Companies are furnishing in the Dominions, just as they are doing here, an essential public service, and they should be allowed to do so without any such paralyzing handicap as this.

The Unremunerative Consumer

At the conference of the British Commercial Gas Association in Leeds last September there was plenty of evidence of the incidence of the unremunerative consumer and of the need for introducing scales of charges calculated to bring about greater equity—in which direction municipally controlled undertakings are in a much better position than companies. It will be recollected that a thorough survey of every customer's account in Leeds revealed "an alarming state of affairs." Commenting on Mr. C. S. Shapley's paper, from which the words quoted are taken, we suggested the desirability of all undertakings carrying out a survey on the same lines, when similar facts would become manifest. The remarks of Mr. T. P. Ridley, at the conference are well worth repeating. Referring to the Newcastle Company, he said: "We have made analyses of our costs and revenue for the various classes of consumers, and the results show that the prepayment consumers as a class were paying £50,000 too little and the industrial consumers as a class were paying £50,000 too much. We cannot transfer that sum from one to the other right away, but must endeavour to bring them closer together gradually. We have found multiple part tariffs, which we have had in operation for two years, a very great assistance in selling gas for industrial purposes; and our industrial department claim that during that period they have not lost any existing gas appliances used for industrial purposes to any competitor, whether oil, electricity, or solid fuels. All undertakings at the present time have not the power to put into operation multi-part tariffs, but I think we are not without hope that it will not be long before we are in that position."

The Australian Gas Industry has had an exceedingly uphill fight during the past three years, and sales have not been maintained. It is natural, therefore, that the Australian Gas Institute, at its recent annual meeting, should have devoted a large amount of time to discussion on this all-important question of rate structure; and extracts from two papers presented on the subject are given in our pages to-day. From these papers it is obvious that a similar state of affairs exists in the Commonwealth as obtains in Great Britain; and Mr. A. J. Dobson, who gives an interesting analysis of consumers' accounts at Adelaide, puts forward a strong plea for the introduction of a service charge into the pricing systems of all Australian undertakings, believing that once the public are acquainted with this method there will be no greater opposition to it than to any other system of charge. An analysis of the consumers' accounts in another undertaking in New South Wales, dealt with by Mr. G. W. Woodbridge, illustrates the inequity of the straight-line rate between consumers. Mr. Woodbridge states that the average quarterly quantity used at the time the analysis was taken was 5833 c.ft., and 63% of the consumers used less than this quantity and were consequently, to a varying degree, carried by the remaining 37%. We would point out that an average figure is not a true criterion of whether a consumer is or is not a paying proposition. For instance, it may be a paying proposition in Mr. Woodbridge's case to supply a consumer with, say, 4000 c.ft. per quarter, which would alter the ratio of "supporters" to "supported." At the same time, the figures given do provide yet another example of the working of the flat meter rate, which means that a small number of consumers with good load factors meet the losses incurred by supplying a great number of consumers with low consumptions and with poor load factors.

An idea of the forms of rate which are in use in Australia may be gained from the data collected by Mr. Woodbridge concerning thirteen undertakings in the Commonwealth. With one exception, all these undertakings employ straight-line rates either in their crude form or else transformed into what are virtually step rates—which are not to be recommended—by the use of scales of discounts. Another feature which obtrudes itself is the continual association of prompt paying with entitlement to the benefits of rebates; and it is significant that the one exception which employs a block rate, with a service charge based on the size of the meter, is a combined gas and electricity company. Perhaps, however, the removal of statutory restrictions by the Gas and Electricity Act of 1932 will change this leaning towards step rates. This Act provides that a company may, with the approval of the Minister, after inquiry by the Commission—(*a*) require guarantees of a specified annual consumption or a specified annual revenue, or make a special charge as a condition of supplying gas to any person; or (*b*) make a minimum charge or service charge to any person supplied with gas by such company. Thus, as far as New South Wales is concerned, the way is clear for a thorough consideration of their positions by the companies.

Methanol, &c.

Of recent years great development has taken place in the application of synthesis to the treatment of water gas and coke oven gas, and in this "Journal" MM. J. W. Osterrieth and Georges Dechamps describe some of the important work which has been undertaken by the Société Franco-Belge d'Ougrée. This development owes its origin to the introduction of the synthetic ammonia process, and it has been rendered possible only by the practicability of carrying out gas reactions at exceedingly high pressures—anything from 1470 to 16,170 lbs. per sq. in.—and at elevated temperatures. The production of hydrogen from coke oven gas is, of course, effected by liquefaction and subsequent fractionation, and the design of this part of the synthetic ammonia plant, in which temperatures of more than 200° C. below zero are obtained, is based on simple physical principles. At first the gases, other than the hydrogen, were valued only on a calorific basis, and were returned together as a "rich gas." However, with the perfection of liquefaction plants, gases were obtained as bye-products whose composition rendered them eminently suitable for the synthesis of compounds other than ammonia; and now the production of methyl alcohol, at a conversion efficiency of the order of 80%, can precede the synthesis of ammonia without interfering with the efficiency of the latter reaction. With this series working, taking the ammonia produced at its normal net value, methyl alcohol is obtained at a low cost.

But the authors show that methyl alcohol is but one of a wide variety of synthetic products which can be produced industrially from coke oven gas. Acetylene can now be made, thanks to the special steels and refractory materials now available. Then there are ethyl alcohol and acetone; and from all these basic products the field of organic synthesis becomes almost unlimited. As the authors state, there are no limits to manufacturing processes except the ever-rising costs through the successive operations and the cumulative effect of individual process efficiencies. One thing is certain, that to make chemical synthesis successful the raw material must be obtainable at a low price and production must be on a large scale; and the natural outlet for alcohols is their use as motor fuel.

Here, however, the facts have to be faced that the petrol producers have more petrol than they know what to do with, and they are willing to sell it at a very low price, and that, despite total nitrogen producing capacity in the world to-day being about 140% greater than the present demand and 100% in excess of the record consumption of 1929-30, synthetic nitrogen plants are still being planned and constructed in a number of countries. One speaker in the discussion mentioned that normally the output of methanol is about 10% of that of ammonia. The world capacity of coke oven gas nitrogen plants may be estimated as about 600,000 tons of ammonia per year, and it is doubtful if it would be possible to find a market for 60,000 tons of coke oven gas methanol per year over and above the output from water gas ammonia plants such as Leuna and the harassed remnants of the wood distillation industry. Also, at the present time, what regulations there are concerning the admixture of alcohols and petrols are designed to help agriculture, and not the chemical industry. Taking note of hydrogenation processes for the treatment of coal or its liquid derivatives from carbonization, our view is that the most profitable use of coke oven gas is at present either at the steel works or for town supply where this is practicable, as it is in South Yorkshire. Concerning synthetic treatment, at

the moment perhaps the most hopeful line lies in the manufacture of acetone and other secondary products, but, as was mentioned in the discussion on the paper, it is questionable whether the Belgian market could absorb the output of the Ougrée plant if worked to capacity, let alone any produced by the other eight nitrogen plants.

However, we call attention to the remarks of Dr. Lessing, who suggested that it is hardly right to apply the measuring stick of present-day economics, and say that under present conditions, with petrol cheap, there is no chance of competing with natural oil supplies. Maybe uses will be found for the synthetic products as readily as the processes for their production have been discovered. At the moment we happen to have reached a phase of world economics at which we are suffering from a glut of practically everything, but it would be rather a weak-minded policy to stop progress for that reason, and not to carry on in spheres of which we know relatively little.

Rating Appeals and Official Practice

THE principles of justice would appear to demand that in all appeal proceedings the decision of the appellate tribunal should be arrived at without the assistance, or even the presence, of the representative of either of the opposing parties in the case. A leading judicial authority has observed that " Equity and Income-Tax are strangers," and it is not surprising therefore to reflect that it was not until 1913 that steps were taken to contest the official interpretation assumed by the Inland Revenue Authorities, that the Inspector (then the " Surveyor ") of Taxes was entitled to remain while the taxpayer withdrew for the Commissioners to determine their ruling in the case under consideration. The Attorney-General in *Rex v. Brixton Income-Tax Commissioners* (*Ex parte Lion Brewery Company, Ltd.*, 29 T.L.R., 712) admitted that this practice was indefensible and contrary to section 57 (7) of the Taxes Management Act, 1880, and the position of the taxpayer was consolidated by section 137 (2) (*a*) of the Income-Tax Act, 1918, which restricts the presence of the Inspector to the " . . . time of the hearing and at the determination of the appeal. . . ."

Our present purpose is to direct attention to an almost parallel case in Rating Practice. Prior to the year 1925 it was generally customary for the officer representing the local Rating Authority to remain during the time when the Assessment Committee considered the appeal, in order, presumably, to assist them in their deliberations. The Rating and Valuation Act, 1925, had the effect, however, of providing against this contingency, and while the Bill was in Committee of the House of Commons a provision was added (now clause 4 of Part III. of the Fourth Schedule to the Act) that: " No person, being either a party to the objection or a witness in the case, or a valuer employed by the Assessment Committee, shall be present while the Assessment Committee are considering their decision on an objection." By clause 3 " any valuer employed by the Assessment Committee to value the hereditament to which the objection relates may be called as a witness."

In view, therefore, of the very definite terms of clause 4, it is all the more surprising that it should have been necessary for the ratepayer (in this instance, Messrs. F. W. Woolworth & Co., Ltd.) to bring an action in the High Court to enforce a strict compliance with the Act. The brief facts are that, while the Surrey County Valuation Committee was not (as it is entitled to be by section 18 (3) of the Act) a party to the appeal, the County Valuation Officer did, in fact, sit with the Assessment Committee, ask questions during the hearing, and was present with the Assessment Committee during consideration of their decision. On behalf of the respondent Assessment Committee it was argued that, as the County Valuation Officer merely remained in order to ascertain the reasons upon which decisions of the Committee were based, and thus to endeavour to promote uniformity in rating, and as he did not interfere with the valuation of the particular hereditament which was the subject of the hearing, his presence was not that of an interested party.

The Lord Chief Justice, in giving judgment in the King's Bench Division, observed, " . . . and the mere fact that he was so present, although no doubt he was present solely for the purpose of obtaining information which might be of use to him in his general capacity of County Valuation Officer, is enough to invalidate these proceedings." The rule *nisi* for a writ of *certiorari* was made absolute. The decision will be of material assistance in enforcing the impartial hearing of appeals under the Rating and Valuation Act, 1925, and those of our readers who contemplate proceedings before Assessment Committees in the near future will doubtless see that this decision is acted upon by the members of the Committees before which they appear, in order that the position which has been established for a number of years past in Income-Tax practice and is now affirmed for Rating purposes may be universally observed in the interests of all parties.

PERSONAL

SIR FRANCIS GOODENOUGH.

Sir Francis Goodenough was able on Saturday last to leave the nursing home for his residence, where he will remain until such time as he is advised to leave London for Devonshire.

* * *

The Accrington Town Council have decided to confer the Freedom of the Borough upon Alderman JAMES WADDINGTON, J.P., C.C., one of Accrington's representatives on the Accrington District Gas Board.

* * *

The wedding took place on Saturday, Jan. 24, at Edinburgh, of Hugh Thurston Cohen, of Messrs. Humphreys & Glasgow, Ltd., son of Prof. J. B. Cohen, of Leeds University and Mrs. Cohen, Coniston, Lancashire, to Margaret Scott Grey, daughter of Mr. J. W. Napier, Gas Engineer, and Mrs. Napier, Mansfield, Alloa.

* * *

Mr. R. J. RESTALL, Works Manager at the Oswald Street Gas-Works of the Burnley Corporation, who has been appointed Engineer and Manager to the Stalybridge Gas Department, was last Friday presented with a gold watch by Mr. J. H. Clegg, the Engineer and Manager, on behalf of the Burnley staff. Mr. Clegg said that Mr. Restall was on the threshold of a career which would be interesting and lead to greater things. His four years' connection with the Department at Burnley had been pleasant and his services had been appreciated.

* * *

Employees of Stalybridge Corporation Gas-Works entertained their ex-Chief, Mr. W. HILL, who has just retired from the position of Engineer and Manager after 31 years, and 43 years' association with the Undertaking, to a social function at which they presented him with a Berkeley easy-chair.

* * *

A Leamington couple—Mr. and Mrs. HENRY FLETCHER, of 4, Gas Street—celebrated their golden wedding last Sunday. They were married at Darley Abbey Church on Jan. 22, 1883. Mr. Fletcher has had a long and interesting career in the Gas Industry, and for the past 35 years has been Distribution Foreman to the Leamington Priors Gas Company. Previous to this he had been Works Foreman and Assistant Fitting Foreman to the Derby Gas Light and Coke Company, while he has also been in the service of other gas undertakings, including those at Kenilworth and Witney. Mr. Fletcher will, in March next, have completed 52 years in the Gas Industry.

OBITUARY

D. D. BRUCE.

The tragic death of D. D. Bruce [noted in our columns last week] is being mourned by a wide circle of friends in Scotland.

A native of Buckhaven, he took a prominent part in the affairs of the Scottish Junior Gas Association (Eastern District) during his service at North Berwick and Buckhaven, and was a Past-President of the Association.

Of a most cheerful and lovable disposition, he was an accomplished swimmer, and, as befits a native of Fife, a very useful golfer. He was a keen Freemason.

He served with distinction during the war with the Royal Engineers, and three years ago plunged into the harbour at Golspie to rescue a child from drowning.

He is survived by a widow and a daughter 4½ years old.

P. B.

* * *

The death has taken place at Burnley, where he lived in retirement, of Mr. JAMES MCGILLIVRAY, who had been 16 years Assistant Manager at the Nelson Gas-Works, four years Assistant Manager at the Burfield Gas-Works, and from 1902 to 1919 Manager of the Granton Gas-Works, Edinburgh. He was a prominent Freemason.

* * *

By the death, at the early age of forty years, of Mr. HERBERT PICKARD, M.Sc., the South Metropolitan Gas Company lose one of their keenest and ablest investigators (states the Company's Co-Partnership Journal). Mr. Pickard, who graduated with an Honours Science Degree at the College of Wales, Aberystwyth, joined the staff of the South Metropolitan Company immediately after the war, at a time when his scientific advice regarding the application of the fertilizers manufactured by the Company was very valuable. Later, Mr. Pickard's knowledge of bacteriology was of great assistance in his study of the cause of contamination by hydrogen sulphide of the water in many of the Company's gasholder tanks. For the last five or six years he had devoted much of his time to the study of tar products, with particular reference to their use as road materials.

THE NEWS OF THE WEEK

A Reduction in the Price of Gas of 1½d. per therm has been decided upon by the Romford Gas Company, as from the reading of the meters for the Christmas Quarter, 1932.

The Institution of Chemical Engineers will hold their annual meeting in the Hotel Victoria, Northumberland Avenue, W.C. 2, on Friday, Feb. 17, to be followed by the annual dinner on the same day.

A Gas Exhibition House has been equipped by the Leamington Priors Gas Company in Northumberland Road, Leamington. All the latest gas appliances are installed, the fires being chosen to harmonize with their surroundings. A gas heater is also fitted in the garage.

The Illuminating Engineering Society's Annual Dinner will be held at the Trocadero Restaurant, Piccadilly, London, W., at 7, for 7.30 p.m., on Tuesday, Feb. 7, 1933. Tickets (price 12s. 6d. exclusive of wine) may be obtained from the Hon. Secretary, Mr. J. S. Dow, 32, Victoria Street, London, S.W. 1.

The Derby Society of Engineers celebrated its jubilee with a dinner at the Royal Hotel, Derby, on Friday night, prominent Engineers from all parts of the Midlands being present. Alderman Sir John Ferguson Bell, Chairman and Managing Director of the Derby Gas Light and Coke Company, and the chief patron of the Society, was in the chair.

The Litetrades Sports Club held their annual dance at the Wandsworth Town Hall on Friday last. As is usual with all the social events of the Club (the members of which are the staffs of Lighting Trades, Ltd., and the Welsbach Light Company, Ltd.), the dance was well attended; the accommodation of the hall being taxed to its utmost capacity.

The Directors of the Commercial Gas Company will recommend, at the Annual General Meeting to be held on Feb. 9, the payment of a final dividend for the year ended Dec. 31, 1932, on the ordinary stock of the Company of £3 5s.% (actual), less income-tax, payable on Feb. 15, making, with the interim dividend of 2½% paid in August last, £5 15s.% for the year.

The Sales of Gas Appliances by the Widnes Corporation Gas Department during the year ended on Dec. 31 last reached the record figure of £10,200—which is equivalent to £1 per consumer. The Engineer and Manager, Mr. C. E. Dickinson, decided to make this record the subject for an advertisement, and accordingly a striking full-page spread was arranged in the local Press emphasizing this remarkable public testimony to the popularity and efficiency of gas for domestic and other purposes.

Manchester District Association of Gas Engineers.—The second joint meeting of the Association with the North-Western Section of the Institute of Fuel will be held on Wednesday, Feb. 8, at the Engineers' Club, 17, Albert Square, Manchester, at 7 p.m., when Mr. H. Hollings, of the Gas Light and Coke Company, will give a lecture entitled "Post-War Experimental Work on Coal Blending."

Oil from Coal.

Writing in a recent issue of the "Investors' Review," Mr. F. D. Mashall, Past-President of the Institution of Gas Engineers, urged the displacement of foreign oil by home-produced oil from coal. The following is an extract from his article:

The production of oil from coal and its solid residue is quite an easy matter for a trained gas engineer to tackle, as, whether he is working at a high or low temperature, the operation is practically the same. The sites, however, for the erection of works are undoubtedly those occupied by British collieries, which have the space, the railway organization and marketing facilities, and the coal.

The collieries produce annually some hundreds of thousands of tons of a small coal or slack passing a ¼-in. mesh sieve for which they are only too glad to find a market, and which they could afford to sell to any process at 9s. 6d. per ton.

It is largely a question of capital, and it must be clearly understood that this cannot exceed a certain figure per maximum daily throughput of twenty-four hours' working—say, 300 days per annum. This sum, the writer can state by experience, must not exceed £300-£350 per ton. For instance, a works with a possible throughput of 500 tons per twenty-four hours, must not cost more than £150,000, or, adding working capital for two years, say, £200,000, which sum would easily yield anything between 7½ and 10% profit.

Plymouth Company's New Clubroom.

A new clubroom at the Plymouth and Stonehouse Gas Light and Coke Company's Recreation Club at Coxside was formally opened on Monday, Jan. 16, by Col. R. L. Norrington, Chairman of the Board of Directors, who is President of the Club. In doing so Col. Norrington said he hoped the fullest possible use would be made of the room by all the employees, not merely one section, because in that way they would further and foster the true spirit of co-operation which was such an important feature of that Company's activities. He acknowledged the kindness of Mr. F. Kil-

THE NEWS—*continued.*

patrick in presenting the billiards table to the Club, and inaugurated the proceedings by playing the first shot.

In accepting the clubroom on behalf of the employees, and proposing a vote of thanks to the Committee and the Directors, Mr. W. J. Walters, Chief Foreman, said it was another instance of the good feeling that existed between the Board and the employees, and they should do all they could to give the Directors heart to continue to study their interests in the future as they had done in the past.

The vote was seconded by the Club's Secretary, Mr. R. Lucas, and supported by the Engineer, Mr. R. J. H. Clark, who said they had a very happy way of all working together, and that he trusted the room and recreation ground which was in the course of formation would help them to spend their leisure hours in equal harmony.

Mr. George H. Bolton, Secretary to the Company, observed that he wished to associate the office and showrooms staff at George Street with all that had been said.

Business and the Schools.

Contributing to a series of articles appearing in "The Spectator," Sir Francis Goodenough, C.B.E., in a recent issue (Jan. 13), emphasized that if business does not consider and determine what it wants of the schools and specify its requirements clearly, it cannot blame the schools if they produce an unsuitable article.

The first essential, stated Sir Francis, is that it should be realized alike by business and by the schools that there are distinct and very different grades of staff required in the commercial operation of a business, and that every firm should have a definite policy of recruitment for each grade, and a clear knowledge of the sources from which the right type of recruit can be obtained for each.

Business requires (*a*) leaders for the formulation of policy and the control of administration; (*b*) senior officers for organization, administration, and supervision; (*c*) trained salesmen to secure business; and (*d*) competent office employees to record transactions, conduct correspondence, and keep accounts.

In the past, when people have talked about commercial education they have had in mind chiefly the fourth and least important of these groups. They have thought almost exclusively of the teaching of shorthand, typing, book-keeping, and correspondence—of the office arts, in short; or else of banking, insurance, auditing, transport, and so forth, all ancillary to commerce but not commerce itself.

The office arts indeed have the same relation to commerce proper as scoring in the pavilion or arranging club matches has to cricket. Commerce is making the runs, playing the game itself—negotiating the contracts, getting the orders, for the office to record and add up. It is organizing and providing the good service that gains and keeps the customer's goodwill—a far more difficult and important affair than keeping his account in the ledger.

What business asks of the schools is to teach our youth how to observe the facts of life, how to form judgments based on facts, how to think and act for themselves, how to exercise initiative, how to take responsibility, how to take risks; to believe in duty and discipline and work; how to lead and manage and develop others—in brief, how to be men—and while doing so to give them the foundations of knowledge that will make them capable citizens in their day and generation.

Finally, what business wants of the schools is recognition by them of the importance (*a*) of close and frequent consultation and co-operation with commerce and industry, in order to ensure on the part of the educationist the fullest possible understanding of the qualities of mind and character demanded in those who aspire to careers in business; (*b*) of taking effective steps constantly to keep business men informed of what education is doing and can do for them; and (*c*) of taking all opportunities of familiarizing themselves with the conduct and conditions and needs of those vital parts of the nation's activities comprised in the term "business."

Forceful Sales Methods in Newcastle.

The Newcastle-upon-Tyne and Gateshead Gas Company are nothing if not forceful and enterprising in their sales methods, and they allow no opportunity to slip by of putting before the public, in a manner likely to create attention and interest, the many ways in which gas can be used to their advantage.

Among a number of recent sales schemes, perhaps the most novel was that carried into effect during the period allowed for renewing motor licences—namely, Jan. 1 to 14. On many days during this fortnight motorists were queued up awaiting their turn, and at both the City and County Licences Offices at Newcastle representatives of the Gas Company handed to every motorist a copy of a folder advertising the advantages of gas for garage heating, a large quantity of this literature being distributed. Force was added to this novel scheme by the fact that the weather, most opportunely, was cold and at times frosty.

Another publicity effort recently adopted by the Company has been the distribution of blotters each month to a selected list of doctors, dentists, architects, builders, &c., with a view to keeping gas always in front of them.

To 75,000 of the Newcastle Company's prepayment consumers, also, an attractively set out circular letter, with an appealing illustration in colour in the bottom left-hand corner, has been despatched. This directs attention to the Company's special offer to slot meter consumers to fix a gas fire in the sitting room on easy terms. These terms comprise 2s. 6d. at the time of order, the balance to be deducted to the extent of 7s. 6d. out of the rebate from the meter, making 10s. in all—no further rent being charged.

Examples of the Newcastle-upon-Tyne Company's novel sales schemes reach us from time to time, and each one testifies to the enterprising and valuable publicity work the Company are carrying out, with a view to keeping gas always before the public eye in this important area.

Need for More Co-Partnership.

In the course of his remarks in support of the Chairman's Address at the annual general meeting of Barclays Bank, Ltd., on Thursday last, Mr. R. W. Edwards, J.P., C.C., Chairman and Managing Director of the Mid-Southern Utility Company, said:

The circumstances of to-day are not new, for if one refers back to the feeling of disquiet which grew in the 'Eighties, resulting in the Commission on the depression of Trade in 1885-86, one finds some illuminating records. Here is a sample taken from the Commission's Report:

> In neutral markets . . . especially in the East, we are beginning to feel the effects of foreign competition in quarters where our trade formerly enjoyed a practical monopoly. . . . In the actual production of commodities we have now few, if any, advantages over them, and in a knowledge of the markets of the world, a desire to accommodate themselves to local taste . . . a determination to obtain a footing wherever they can, and a tenacity in maintaining it, they appear to be gaining ground on us. We cannot avoid stating here the impression which has been made upon us during the course of our inquiry, that in these respects there is some falling-off among the trading classes of this country from the more energetic practice of former periods.

And a contemporary commentator adds:

> The information collected by the Commission, while tending to dispel much misapprehension . . . and to encourage a more hopeful view . . . of our commercial position, will also show that if our position is to be maintained it must be by the exercise of the same energy, perseverance, self-restraint, and readiness of resource by which it was originally created.

Thus does history repeat itself.

It would not be competent for me to offer here criticism on the lines of this Report, but I do suggest that the circumstances of the 'Eighties are not unlike the circumstances of to-day, and that the British Empire, while making a large family circle of itself, must not overlook the fact that there are other countries outside the circle with whom they have to compete, and that competition can only be successfully met by the application of those principles to which I referred just now.

We cannot refresh our minds and those of our employees too often with what is necessary for our success in future—especially would it be helpful if there can be brought into more general operation some scheme of co-partnership whereby the interests of employers and employees become identical. This principle both experience and observation have taught me can be of inestimable value in avoiding those uneconomic dislocations of business—strikes, lock-outs, and disputes—which have so marred the face of our industrial world, especially in the present generation.

Forthcoming Demonstrations at Leeds.

The Leeds City Gas Department have arranged a gas cookery and washing demonstration to be held at the Leeds Town Hall, on the afternoon of Feb. 7, under novel and interesting circumstances.

The Victoria Hall—the great concert and exhibition hall of the building—has been taken for the occasion, as a big crowd is expected. The proceedings are to open with a recital on the grand organ by Mr. J. H. Richardson, a member of the Gas Department staff, after which the Lady

Mayoress (Mrs. R. H. Blackburn) will officially witness Miss Kirkby, the demonstrator, place a completely prepared but uncooked dinner in the latest type of gas cooker. The cooker will then be sealed, and for the next hour Miss Kirkby will demonstrate the cooking by gas of a varied range of dishes, and simultaneously there will be proceeding a silent demonstration of washing, drying, and ironing by gas appliances. An ordinary average family wash will be completed in one and a quarter hours. At the end of one hour the Lady Mayoress will unseal the cooker containing the dinner and a committee of ladies will inspect and comment on the result. The proceedings extend from 2.45 to 4.30 p.m.

Mr. Ralph Halkett's Advice to Young Students.

The importance of earnest application to study in preparing for a career in the Gas Industry was urged by Mr. Ralph Halkett (General Manager of the Sheffield Gas Company), in presiding at the first of a special course of six lectures on gas technology, arranged in connection with the Sheffield University Department of Fuel Technology, at the Applied Science Department on Jan. 19.

The lecturer was Dr. H. A. Fells, of Sheffield, whose subject was "Gas for Industrial Purposes."

Mr. Halkett stressed the need of steady and regular attendance at classes, combined with regular study to fit themselves for the jobs they desired. Without study, they could not master their jobs, either in theory or in practice.

The works and workshops could give them the practice, and they could turn to such lectures as that to assist them in gaining theoretical training. A combination of these was invaluable.

Urging specialization, Mr. Halkett said that the student who steadily and perseveringly worked at one department until it was perfectly his own, was paving the way for general efficiency, while he who flitted from one subject to another soon became incapable of any genuine persistent labour. True success was built not on accident and chance, but on stability of purpose and endeavour.

"Any young man entering the gas profession nowadays must make up his mind that it is only by sheer hard work and study that he can hope to reach the highest ranks; and although it is not possible for everyone to get there, I would not like to see any man try for less," said Mr. Halkett.

"No man knows his capabilities until he puts them to the test, and many capabilities lie dormant until brought out by circumstances.

"Therefore it behoves every man to make his aim a high one, and get as near attainment as his talents will allow. To-day, there is more room than ever before for ambitious and efficient men—and men with high ideals and a broad outlook."

Gas and the Industries of South Wales.

Writing in the recent Trade and Industrial Supplement of the "South Wales Evening Post," Mr. W. H. Johns, M.I.Mech.E., Engineer and Manager of the Swansea Gas Light Company, drew attention to the part gas is able to play in the industries of South Wales.

The Gas Industry during the past year, said Mr. Johns, has continued to be identified most prominently with the endeavours of manufacturers in re-organizing industry to conform efficiently with the exacting needs of present-day economic forces; and town gas—originally a domestic rather than an industrial fuel—is becoming more and more in demand by manufacturers for processes requiring heat.

The Gas Industry is an outstanding example of co-operative effort. Scientific research and experiment has been carried out by individual undertakings for very many years, and the experiences of these individuals have been collated for the benefit of the whole Industry. Reliable data has been amassed from practice and research in various parts of the country, and the free and ready diffusion of this data enables any and every gas undertaking to approach problems of industrial gas with the force of experience of the whole Industry.

The Gas Industry asks no manufacturer, by converting any appliance or plant to gas heating, to take the risk of a leap in the dark, because means are already in existence for testing the capacity and cost of gas to satisfy particular requirements without any necessity to scrap existing equipment or to incur additional capital outlay.

Perhaps the most significant feature of the Industry's progress during recent months is the success which has attended the experiments in the use of gas for driving internal combustion engines.

It is important to note, added Mr. Johns, in conclusion, that the Gas Industry is one of the largest coal consumers in the country. An increased demand for gas is reflected immediately in an increased demand for coal, and impartial and competent authorities are emphatic that the only way "back to coal" is *via* the Gas Industry.

Gas Progress at Hinckley.

The Hinckley Gas Undertaking reports continued progress. At the last meeting of the Urban District Council, Mr. J. Bennett, the Chairman of the Gas Committee, said the Manager (Mr. A. B. Britton) had reported that the new mains estimates amounted to £3500 approximately, leaving only £1500 out of the loan which it was decided to apply for in July last for stoves and meters.

The increase in consumers was costing at least £1000 to £1200 a year in meters alone, and it was the opinion of the Committee that the loan which had been applied for should be increased from £5000 to £7000. It was recommended that the resolution passed by the Council to apply for a loan of £5000 for new mains, meters, and stoves be rescinded, and in lieu thereof application be made to the Ministry for their sanction to the raising of a loan of £7000 for the laying of new mains and for the purchase of meters and stoves.

The Manager had placed before the Committee a plan of proposed alterations at the works for the purpose of providing additional store room, and it was recommended that the plan be approved, and that the work be carried out by the Council's own workmen at an estimated cost of £150. The Council adopted the report.

Incorporated Accountants' Year Book.

The Incorporated Accountants' Year Book, 1933, being the 46th volume of the series issued by the Council of the Society of Incorporated Accountants and Auditors, is now published. The volume extends to 1132 pages. Alphabetical and topographical lists of members and firms (of which at least one partner is an Incorporated Accountant) are set out. The book contains the names of 5910 members, of whom 4851 are in England and Wales, 131 in Scotland, 147 in Ireland, and 781 in the British Dominions, Colonies, and in foreign countries.

The Society has Branches and District Organizations in the leading cities and towns of Great Britain and Northern Ireland and throughout the British Dominions. There is indicated against the name of each town the Branch or District Society in the area of which it is situated. A special section of the book is devoted to the examinations and publications of the Society, to the facilities at Incorporated Accountants' Hall, and to the Incorporated Accountants' Benevolent Fund.

The Romance of a Lump of Coal.

On Thursday, Jan. 12, Mr. Walter T. Dunn, M.I.Mech.E., F.C.I.S., formerly Secretary to the Institution of Gas Engineers, gave a lecture on "The Romance of a Lump of Coal" before the Hastings Branch of Toc H—Mr. C. Griffen presiding.

Upwards of ninety lantern slides were shown in illustration of the lecture, which had been kindly loaned by Major F. J. Bywater, M.C., of the South Metropolitan Gas Company's Newcastle-upon-Tyne Coal Testing Office; Sir Francis Goodenough, C.B.E. Mr. W. J. Tennant, F.C.I.P.A., of the firm of Messrs. Boult, Wade, & Tennant, Chartered Patent Agents; and others.

The members of Toc H followed the lecture with the keenest interest, from the formation of the coal centuries ago to its carbonization in gas-works. Coal, as applied in locomotives and stationary engines, in the marine engine in the navy and the mercantile marine, was referred to; and the process of extracting oil was emphasized as a means of assisting the coal industry. The "Back to Coal" slogan was considered, and warning expressed that the phrase should not imply a return to the use of raw coal in domestic grates, but rather to investigations of problems having for their object the making available, by hydrogenation and other experimental processes, of oil to replace the enormous tonnage of foreign-produced petrol. Particulars were given of the latest work of using compressed gas for the propulsion of road vehicles at Birmingham and other places.

Mr. Dunn briefly indicated some of the multifarious applications of the derivatives of coal, including disinfectants, tar for roads, dyes, fertilizers, &c.

At the conclusion of the lecture, a discussion took place in which a number of the members participated, and a cordial vote of thanks was passed to Mr. Dunn for the interesting evening he had provided.

SMETHWICK'S ENTERPRISE

Extending the Applications of Gas on the District

Recently the Smethwick Gas Department has carried out a number of interesting contracts extending the application of gas on the district, and we feel sure that the following notes, for which we are indebted to Mr. Ernest Hardiker, Engineer and Manager, will be of interest to the Industry generally.

Central Heating—Law Courts.

There have recently been built new Law Courts in the Borough. Formerly the Borough had had no separate Court of Justice, although for nearly half-a-century the law had been administered in its borders, first by the County

Law Courts, Smethwick.

Magistrates, and in more recent years by Justices appointed to the Borough Bench and by the Recorder.

The building, which was designed by Mr. Chester Button, A.R.I.B.A., Architect of the Borough Engineer and Surveyor's Department, and erected by direct labour under the direction of the Borough Engineer and Surveyor (Mr. Roland Fletcher, Assoc.M.Inst.C.E.), occupies a position at the junction of Crocketts Lane and Piddock Road. The site was chosen by the Watch Committee owing to its close proximity to the Police Station Buildings, and in planning the building the principal entrance has been placed on the main axis which bisects the angle of the two roads.

Among the rooms of particular interest are Courts Nos. 1 and 2, Recorder's room, and waiting hall. Court No. 1, which will be used for Petty and Quarter Sessions, has panelled walls in quartered figured European oak forming a dado. Oak has also been used for the Magistrates' bench, and the fixed seating for jury, court officials, &c. The dock is approached in the conventional way by a flight of steps from the waiting rooms in the basement. The ceiling is panelled with moulded fibrous plaster beams, the centre panel having a fixed ornamental laylight of steel with stained glass relief and lighted from a roof skylight. Natural light and ventilation are obtained by clerestory double windows controlled by opening gear from the corridors, and foul air is extracted through fibrous plaster ceiling grids by an electric fan installed in the roof enclosure. The flat surfaces of the ceiling and walls above the oak panelling have been covered with acoustical perforated tiles flat painted, which have a pleasing effect.

Court No. 2 will be used chiefly as a Coroner's Court, and for juvenile offenders. The walls are panelled in oak with plaster beams and cornices; no fixed seating is provided as in Court No. 1, and the furnishing of this room is on informal lines. The Recorder's room is also panelled in oak, with a gas fire surround and hearth of 1½ in. red antique hand-made sandfaced brick.

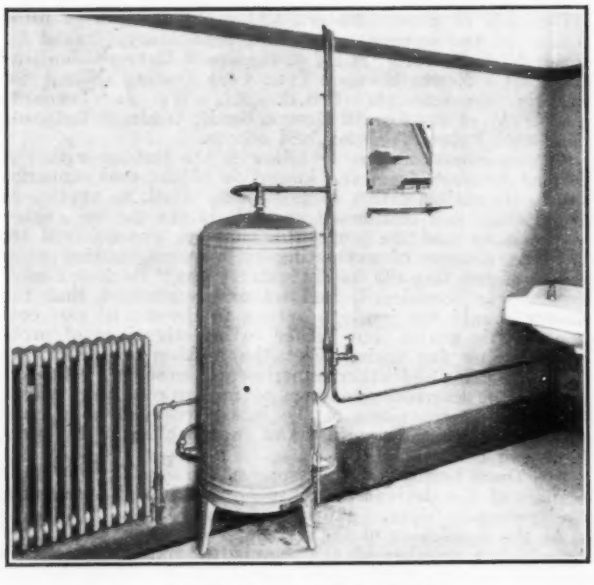
The waiting hall has a dado carried out in natural San Stefano marble in ashlar design with architraves and capping in Napoleon, and skirting in Belgian black marble. The floor is also laid with marble squares and panelled insets unpolished. The ceiling is panelled with plaster beams and cornices.

The remainder of the rooms and offices have distempered plaster walls, the joinery being carried out in Columbian pine. Bronze metal door furniture is used throughout. All woodwork is stained and wax polished. Terrazzo has been used for the dado and floor of corridors and lavatories. The remainder of the floors are of oak blocks, laid herring-bone pattern, with square borders.

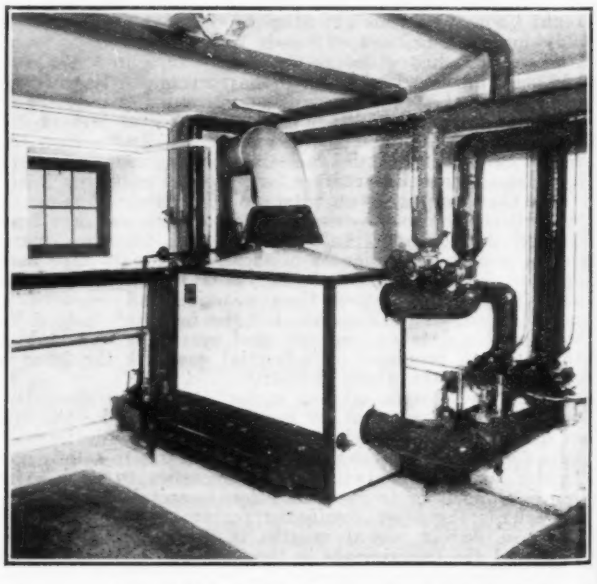
The building is built of brick: the first floor and roof flats are constructed of hollow tile and reinforced concrete beams, the flat roof being covered with asphalt. The elevations have been carried out in 2½-in. local multi-colour rustic brick and re-constructed "Weldon" stone. Surmounting the main entrance is the Borough Coat-of-Arms in coloured enamels on bronze, fixed to a stone shield. The windows consist of steel casements in wood frames. The pitched roofs are covered with a red sand-faced Roman tile. Heating is by a gas-heated low-pressure hot-water system.

Quotations were received for electric tubular heating, coke-fired low-pressure hot-water system, and gas-fired low-pressure system.

With electricity at 0·7d. per unit the cost of electric tubular heating, including interest and depreciation, was estimated at £284 per annum.



A "Sunhot" for Hot Water Supply.



"Ideal" Gas-Fired Boiler for Central Heating.

The coke-fired system, allowing for labour, interest, and depreciation, would have cost £146 per annum.

The Watch Committee decided to install a gas-fired boiler, and the estimated cost, with gas at 1s. 6d. per 1000 c.ft., including interest and depreciation, was £151 per annum. The actual cost for last year, including testing and drying out the building, was 28s. in excess of this amount.

The boiler is a No. G.W.11 "Ideal," supplied by the National Radiator Company, and the installation is fitted with automatic control throughout. The system is divided into three separate circuits, one of which supplies the administration block—*i.e.*, entrance hall, offices, corridors, cloak rooms, &c. The second supplies the main court, waiting rooms, Magistrates' room, &c., and the third the minor court and adjacent offices. Each of these circuits

The New Abbey Road Schools.

is controlled by a room thermostat, operating on a low-voltage relay, which brings into action a motorized valve on the return water pipe.

The boiler is also fitted with a temperature thermostat on the water outlet, which operates on a snap-action gas valve, and, in addition, the same valve is controlled by a motor which cuts off the gas when all three valves on the water circuits are shut off at the same time.

The room thermostat in the administration block has a clock control which increases the operating setting of the thermostat an hour or two before the offices are required to be used, and reduces the room temperature setting about an hour before the offices are vacated at night.

The whole system has worked during the last winter quite automatically and perfectly satisfactory.

The building, which is about 84,000 c.ft. capacity, has been heated with a consumption of gas of 30,000 c.ft. per week as a maximum, the average being about 24,000 c.ft.

It should be noted that in Smethwick the following are the charges for gas used for central heating:

Up to 100,000 c.ft. per quarter—
2s. per 1000 c.ft., or 5·3d. per therm.

Over 100,000 and under 500, co c.ft. per quarter—
1s. 9d. per 1000 c ft., or 4·7d. per therm.

Over 500,000 and under 3,000,000 c.ft. per quarter—
1s. 6d. per 1090 c.ft., or 4d. per therm.

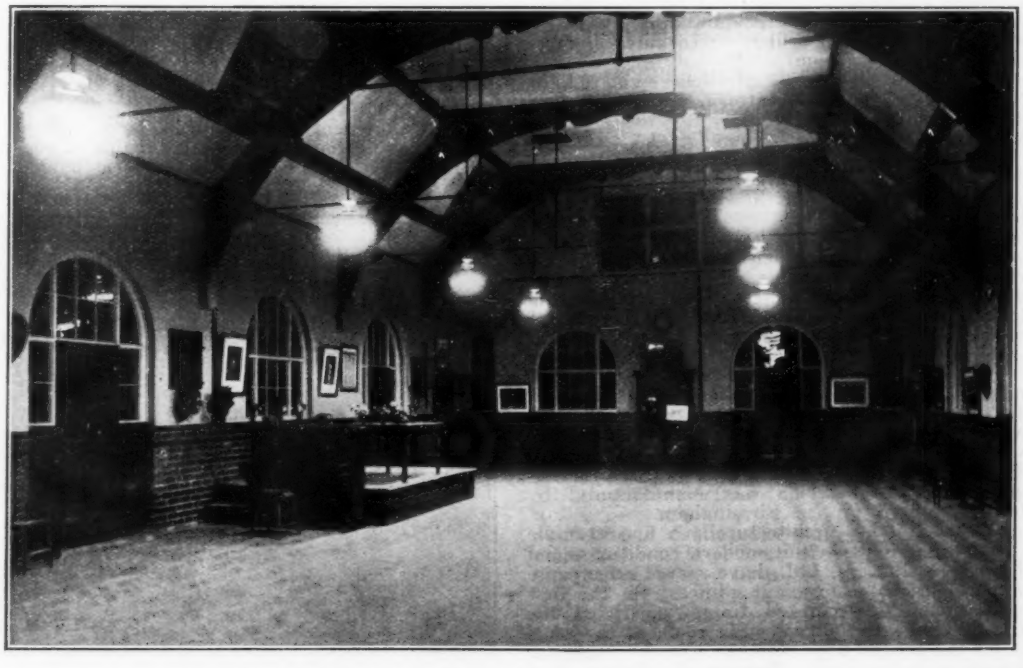
School Lighting.

Another scheme was the re-lighting of elementary schools at Abbey Road. These schools had been lighted by gas with very old centre pendants, and as the re-lighting had become essential, quotations were asked both for electric and gas lighting.

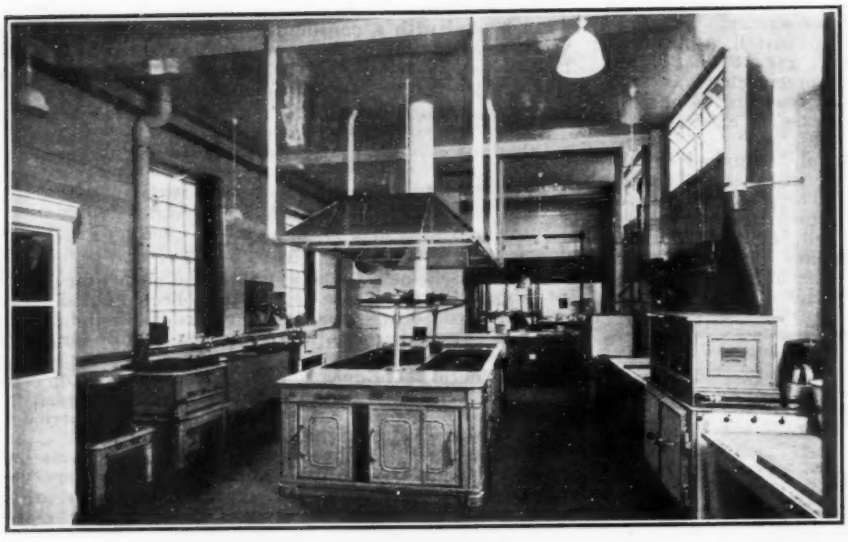
The Smethwick Education Committee decided in favour of gas lighting, and accepted the scheme proposed by the Gas Department, and the necessary work was carried out by the Department during the August vacation.

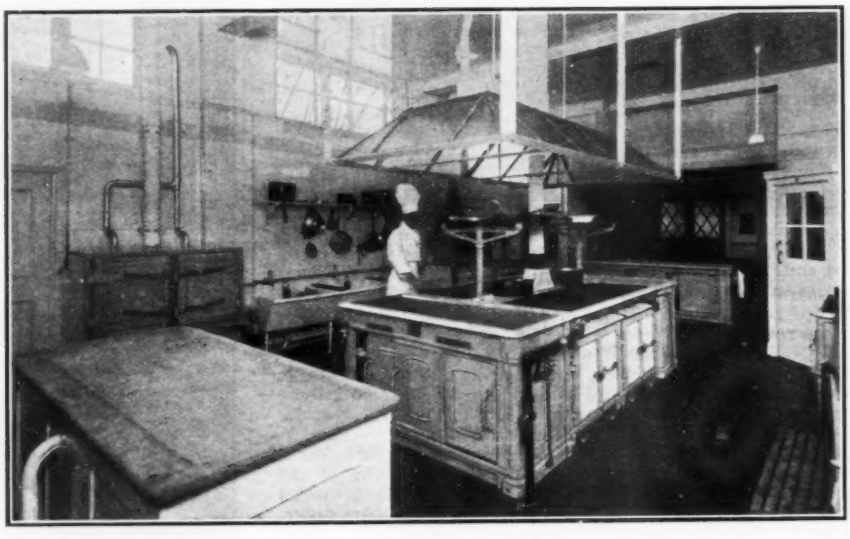
There are, in all, nineteen class rooms and two halls. Lighting has also been modernized in the corridors, cloak rooms, and staff rooms. Six of the class rooms are approximately 24 ft. by 17 ft. 6 in., and these have been

A Classroom at the Abbey Road Schools.



ASSEMBLY HALL, ABBEY ROAD SCHOOLS, SMETHWICK.





TWO VIEWS OF THE KITCHEN OF THE BLUE GATES HOTEL, SMETHWICK.

lighted with three 4-light deep reflector " Worklite " lamps. The larger class rooms, which are approximately 24 ft. square, are lighted with four 4-light " Worklite " lamps, also with deep reflectors.

The large hall—70 ft. by 32 ft.—has eight 6-light " Worklite " lamps of the same pattern, and the smaller hall five 6-light lamps.

The illumination of the class rooms at the minimum points has been increased tenfold, the average illumination being 10 foot-candles, and the ratio of maximum to minimum 3·5 : 1. The assembly halls have the same average illumination, with a ratio of 5 : 1.

The rooms are entirely free from glare, the lamps being set 10 ft. above the ground, which is, at the front, approximately 1 ft. above the line recommended in the Report of the Technical Committee of the Illuminating Engineering Society on the " Artificial Lighting of Schools " for the prevention of glare.

Hotel Kitchen Equipment.

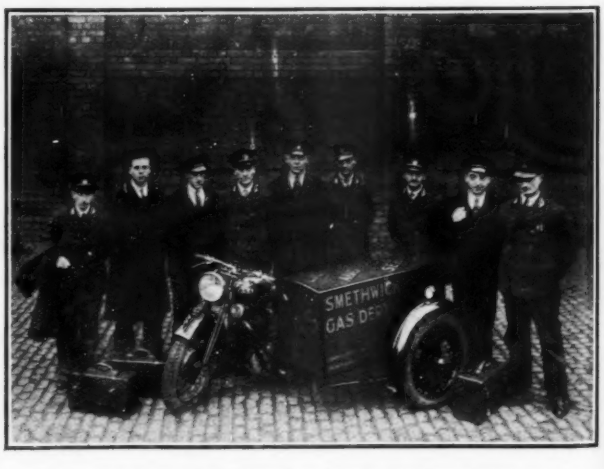
On account of road improvement schemes, the principal hotel in the town is being demolished, and on an adjoining site a new hotel has recently been erected.

The whole of the kitchen equipment has been supplied and fitted by the Gas Department, and comprises the following apparatus, all of which was manufactured by Messrs. John Wright & Co., of Birmingham.

The Blue Gates Hotel is architecturally a fine example of an old hostelry re-built to suit modern conditions, and Messrs. Mitchells & Butlers, Ltd., have spared no expense to erect a pleasing and convenient edifice. On the first floor, a large tastefully decorated dining-room is at the front of the building, and an assembly room at the rear. Below this, on the ground floor, another assembly room for Masonic functions is provided. Between the dining room and the assembly room on the first floor, a spacious and well-equipped kitchen is to be found, connected by a lift to the assembly room on the ground floor.

The whole of the kitchen equipment is in grey mottled-enamel finish with white enamelled panels; and as the walls are finished in white tiles, the kitchen has a clean, airy appearance.

The equipment consists of a large " Bordo " central range having four ovens, each capable of roasting 66 lbs. of meat or the equivalent duty, such as baking sweets, &c.



Maintenance Staff of the Smethwick Gas Department.

The ovens are in pairs, back to back, and surmounted with a hotplate having a wide assortment of burners for general boiling, frying, &c. At each end of the range a hot closet with "bain marie" top is fitted for keeping food hot during service, and for warming plates and dishes.

This central unit is 11 ft. long by 5 ft. 6 in. wide, and over it a glass canopy is fixed to ensure the proper ventilation of the kitchen. At each end of the kitchen adjacent to the serveries a "Sector" carving table with hot closet below is provided. These are fitted with wells for carving, and bain marie for keeping food hot. Covers for the wells are suspended from overhead rails with counter-balanced gear. In addition, other apparatus consists of a "Celt" double steamer for steaming vegetables, fish, and similar dishes (this is so designed that the water level is automatic controlled); a "Friar" fish range; an "Atlas" gas-heated stand for stock; and a griller and toaster with a hot closet below.

Meals have been served to upwards of 300 persons simultaneously, and the cooking apparatus is such that the staff are able to work under ideal conditions.

Universal Maintenance Scheme.

The Smethwick Gas Committee have recently inaugurated a scheme which includes the adjusting and cleaning of indoor lighting burners, gas fires, radiators, irons, water heaters, and adjusting and cleaning of burners on cookers—the whole of the cost of labour being borne by the Department. The consumer only pays for replacements and renewals.

The work is supervised by a charge hand who is provided with a motor bicycle fitted with a commercial side-box. After meeting his men in the assembly room, and arranging their work for the day, he tours the district inspecting work which has been carried out, and, if necessary, replacing from a stock in his side-box materials which the men have sold.

Each maintenance man is provided with a valise containing tools, mantles, radiants, and small parts for burners which may be required for replacements. He inspects the main cock and meter at each installation, reporting on the conditions of these, and then cleans and adjusts various appliances on the premises.

A circular letter is sent to each consumer, preparatory to the visit of the maintenance men, and generally the men are being well received by consumers.

It is hoped that ultimately the maintenance man will be able to visit each domestic consumer in the Borough at least twice per annum; although fires at doctors, dentists, and public buildings are visited more frequently.

. . . GAS IN THE . . . WIRE DRAWING INDUSTRY*

Experience in Halifax

By J. Bradbury, of the Halifax Gas Department.

The wire trade provides many opportunities for the development of the gas sales, due to the many processes in which controlled heat is imperative.

The raw material of the wire mill consists of wire rods which are obtained from the steel ingot or billet by hot rolling. These rods are made as nearly round as possible and vary in diameter from ½ in. to slightly under ¼ in., the majority used being 0·212 in. diameter or 5 S.W.G. The wire is drawn by pulling the rod through a tapered hole in a die or drawplate, and the final size of the tapered hole is smaller than the size of the rod by the amount it is desired to reduce the rod in a single "pass."

Before drawing can be started, however, it is necessary to reduce the end of the rod to a diameter which will allow it to be passed through the die. There are various mechanical methods of doing this, but here is the beginning of the many processes to which gas is applied in the wire trade.

Pointing.

The wire has to be pointed, and for this process a small furnace 18 in. long, 6 in. wide, and 6 in. high is used. Several rod ends are passed through the furnace and secured by a clamp. At the side near the coils the rods are secured to a carriage which runs on a traverse. By means of four gas and air blast burners the portions of the rods which are in the furnace are raised to a temperature of approximately 1200° C. The carriage is then wound back along the traverse and the rods drawn out until they break. The result obtained is a very fine taper at the end of each rod. Twelve to sixteen rod ends are pointed at one time in this furnace, and the time taken for each pointing is from seven to eight minutes. The furnace consumes 300 c.ft. per hour.

Annealing.

Returning to the drawing process, it will be readily understood that the process of reduction in the size of the wire cannot be carried on indefinitely in view of the fact that every pass through the drawing dies decreases the ductility and increases the hardness of the metal until a point is reached at which it becomes so brittle that it breaks. Before this breaking point is reached, however, the wire must be annealed, and this means that it has to be heated to a temperature which will restore its ductility before further drawing may be carried out. By drawing and annealing alternatively steel can be reduced to the dimensions of human hair. The annealing of mild steel or iron wire presents little difficulty. The wire is packed into steel containers which are then placed into a furnace, heated to 650° to 850° C. and soaked from two to ten hours, cooled in the furnace to 400° C., and then withdrawn. The soaking time depends on the gauge and class of wire under treatment. Different wire manufacturers vary the heat treatment on the same class of wire, with various results. Owing to the advantages of gas firing, gas-fired furnaces of the "inflamiec" type fitted with atmospheric burners are replacing solid fuel furnaces for this process. The following is the result of a test on the annealing of florists' wire:

Furnace temperature before insertion of charge, 800° C.
Size of furnace chamber, 3 ft. by 2 ft. by 1 ft.
Gross weight of load, 1420 lbs.
Nett weight of load, 1075 lbs.
Gas consumption, 2460 c.ft.
Gas consumed per lb. of gross load, 1·73 c.ft.
Gas consumed per lb. of wire annealed, 2·29 c.ft.

Heat Treatment.—Heated charge to 750° C. and maintained for two hours. Charge allowed to cool in furnace to 600° C. and withdrawn. Wire taken out of containers and allowed to cool in air.

Result.—Very soft wire with blue black colour. The life of the containers was much longer in the gas-fired furnace due to the reducing atmosphere.

The process of "white" or "close" annealing is used for wire which must be absolutely free from scale after annealing. This process is carried out in the following manner by one of the wire manufacturers in Halifax. The coils are packed in a cylindrical container and sealed. By means of an inlet port at the bottom of the container and an outlet port at the top, gas is passed into the container until all the air is expelled and replaced by gas. The ports are then sealed and the container is ready for the furnace. The furnace consists of a circular pit into which the container is lowered, and velocity burners fire into the annular space thus formed.

Heat Treatment.—The charge is taken to 700° C. and maintained for three to four hours at this temperature. The container is then removed from the furnace and gas is passed through it by means of the ports previously mentioned, until the wire is quite cold.

Result.—The wire is quite free from scale and uniformly annealed. A figure of 4·5 c.ft. per lb. of wire is an average for this class of anneal.

Heat Treatment of High Tensile Wire.

High tensile wire used in the manufacture of wire ropes, spring wire, piano wires, aircraft wires, and other wires where the hardening effects of cold working are utilized, is subjected to an entirely different treatment known as "painting." Very little information is available on this subject, due to the reticence of wire manufacturers to divulge their methods, but it is definitely known that vastly different heat treatments are used to obtain the same results.

The process is continuous. The coils are placed on swifts

* Paper before the Yorkshire Junior Gas Association, Jan. 21, 1933.

at one end of a long furnace through which the rods or wire are then threaded and fastened to rotating blocks which wind the wire through the furnace. The speed of the wire and the length of the furnace are so arranged that the wire is in the furnace long enough to reach the desired temperature and be maintained at that temperature for a definite period. By this means the wire is heated gradually to a temperature of from 900° C. to 1100° C., and on reaching the exit is cooled in air or by means of a lead bath.

Coal gas or producer gas is mostly used for heating, and although I have no information regarding the gas consumption for this class of work you will be interested to know that an experimental plant is at present in course of construction in Halifax and we hope that the data obtained will be published at a later date.

Hardening and Tempering.

Steel wires of various carbon contents are hardened and tempered. This process requires great care and accuracy. The method which I shall describe is in general use throughout the wire industry and is far from satisfactory.

Various degrees of temper are required, and although different types of fuel have been experimented with from time to time, gas is almost universally used at present.

The wire is passed through the flame of gas and air blast bar burner of sufficient length to enable the wire to reach the desired hardening temperature, and it is then quenched in oil or other quenching medium. The wire then passes through a second burner which is shorter. The temperature reached is only sufficiently high for the degree of temper desired to be obtained, and the wire is again quenched. When heated in this way the outside of the wire has a tendency to reach the temperature of the flame through which it passes, and if the outside of the wire is not burnt the core is underheated. This is the main reason why the method is unsatisfactory. Experiments are to be carried out in Halifax to try to overcome this difficulty. We propose to pass the wire through a semi-muffle type furnace in which a reducing atmosphere will be maintained, and the temperature at which hardening of the wire takes place will be constant over the entire length. The furnace will be approximately 6 ft. long, 2 ft. wide, and 1 ft. high in chamber. Tempering will be effected by means of a lead bath or a bath containing a suitable alloy. Where bright hardening and tempering is desired, suitable gas seals will be employed between the heating and the quenching mediums.

A test taken on four hardening and tempering machines employing gas and air blast burners showed an average gas consumption of 20 c.ft. per lb. of wire treated.

The gauges of wire ranged from 24 S.W.G. to 36 S.W.G.

Tinning.

The process of tinning wire by passing the wire through a suitable flux and then through a gas heated bath of molten tin is recognized in Halifax as ideal. In Halifax at least twenty baths heated by gas are in daily use. Gas for this process has been adopted in place of coal, coke, and electricity. Running costs are extremely low. We have recently replaced a coal fired tinning bath by a gas fired bath designed and constructed at our works. Heating is effected by a low-pressure atmospheric burner of the grid pattern, the maximum consumption being 120 c.ft. per hour. The bath is 20 in. square and 3½ in. deep and holds approximately 3¼ cwt. of tin. The time taken to heat the bath to the working temperature of 260° C. is 58 minutes. A test taken of a period of one hour in the middle of an eight-hour shift gave the following result:

Eight 24's gauge wires at 200 ft. per minute each wire.
Weight of throughput, 116 lbs.
Gas consumed, 84 c.ft.
Gas consumed per lb. of wire tinned, 0·72 c.ft.

Galvanizing.

The galvanizing of wire is carried out in practically the same way as tinning, except that the bath contains molten zinc instead of tin. The bath is usually heated by coke, and although attempts have previously been made in Halifax to use gas for this process, it was only in June, 1931, that a gas fired galvanizing bath successfully replaced a coke fired bath. Since that date others have been installed.

In the design of a galvanizing bath the most important factors are (1) that the heating should be as uniform as possible, and (2) that side heating only should be employed.

An experiment was carried out in Halifax in 1930 when a coke fired bath of 3 tons of spelter capacity was converted to gaseous fuel. Heating was effected by means of Cox " Ignite " combustors arranged around the sides and ends of the bath, and the products of combustion were taken away by a flue running under the bottom of the bath. While the heating was entirely satisfactory, the high gas consumption per lb. of wire galvanized—7 to 7·5 c.ft.—was not an economical proposition, and the bath was again re-built for coke firing.

It became evident that factors which had previously been ignored would have to be considered if a galvanizing bath heated by town gas was to become a commercial proposition. The spelter capacity of the bath was out of all proportion to the weight of throughput. When an inquiry was received in January, 1931, for the replacement of a coke-fired bath of 3 tons spelter capacity it was suggested that a bath with a capacity of 10 cwt. of spelter would be sufficient to give the output desired, which was 30 cwt. per day of 24 hours, with gauges of wire 20-24 S.W.G. It was decided to install a suitable bath on approval.

Heating is effected by four burners fired with Selas low-pressure atmospheric injectors, arranged two at each end. The bath itself is made from a special alloy which has been found to resist the action of molten zinc and is 1 in. thick.

The sides and ends are protected by 1 in. lining of Glenboig firebrick.

When the bath is in position the setting is divided into two by a brickwork projection from the side walls, and thus the two burners at one end of the furnace are entirely independent of the two at the other end.

The burners fire into the combustion chambers round the sides of the pot and the products of combustion are discharged over the surface of the metal, to reduce oxidation. The secondary air is passed underneath the pot and is preheated. The cooling effect on the bottom of the pot reduces the formation of dross.

This method of heating the bath has shown distinct advantages:

(1) The formation of dross was only 25% of the amount produced in the coke-fired bath.
(2) Great reduction in labour.
(3) Uniformity of product.
(4) Longer life of bath.

In a recent test a figure of 1·99 c.ft. per lb. of 24's gauge wire galvanized was obtained in the bath. This gave an all-in cost per ton of £1 10s. 3d. against £1 9s. 6d. for the coke-fired bath.

The difference was more than offset by the longer life of the bath, the saving in space, and the decreased amount of dross formed.

An order for a gas-fired galvanizing bath was received ten days ago, and when this is installed every wire firm in Halifax who galvanize their products will have at least one gas-fired bath.

Enamelling.

The enamelling of upholstery springs made from hard drawn wire afforded us a further opportunity for the use of gas in one of the local wire mills. This consumption was obtained in spite of keen competition from oil fuel. The process is a continuous one, and the only labour involved is that of a boy who takes off the finished springs and replaces them by springs which are to be enamelled.

The stoving temperature is 450° F. and the stove has an output of 5 to 6 gross of 12 in. by 6 in. springs per hour and a gas consumption of 70 c.ft. per gross of springs enamelled.

In 1930 the firm where this stove is now installed consumed 64,000 c.ft. of gas per annum, and their present consumption is approximately 3½ million c.ft. of gas per annum. This increase is due to the fact that we have replaced one coke-fired galvanizing bath by a gas-heated bath, one coal-fired tinning bath by a gas-fired bath, and one electrically heated tinning bath by a gas-fired bath, in addition to the installation of the enamelling stove. It is possible that the consumption will be further increased by the replacement of a coal-fired annealing furnace by a gas-fired furnace. The output of wire from this furnace is approximately 15 tons per week.

Although I have made gas for process work in the wire trade the main theme of this paper, there are several other trades I wish to mention where we have found gas to be the fuel which is particularly suitable.

Annealing of Staybrite Steel Spinnings.

The annealing of Staybrite steel spinnings is a process which requires great care. Atmosphere control in the furnace is essential, because oxidation pits the surface of the metal and the pits cannot always be removed in the polishing process. It is necessary, therefore, to maintain a reducing atmosphere in the furnace chamber, and also cooling should be so arranged that possibility of oxidation is eliminated. Tests carried out at our works resulted in the installation of a gas-fired furnace.

Annealing is effected at 950° C. The spinnings are treated in the same way as in the close annealing of wire. The work is of an intermittent character, and therefore the insulation of the furnace was increased so that during stand-by periods the heat loss was slight and the working tem-

perature could be regained in a few minutes. The gas is, of course, shut off during the stand-by periods.

An alternative method, which, however, is not practicable in the annealing of Staybrite spinnings, is to heat the spinnings in a furnace of the Walter-Palser pattern and to quench in water. The gas seal in front of this type of furnace prevents oxidation before quenching. Wire annealed in this manner is quite satisfactory.

Electro-Plating Industry.

The heating of tanks, sawdust pans, and drying and enamelling stoves used in the electro-plating industry can be successfully done by gas.

Recently we converted to gas, on approval, a bath heated by electrical immersion heaters, and this conversion resulted in the adoption of gas throughout the works for all heating processes, and a saving was effected of 30% in fuel costs.

Printing Industry.

Gas is used in several processes in the printing industry, and is particularly applicable for the melting of stereo metal, the heating of the pots on linotype machines, and for re-ingotting and matrix drying. Our hold on this type of work must be strengthened, because greater competition from oil and electricity is in evidence.

The melting of stereo metal by gas is in serious competition with oil fuel. The following details of competition experienced in Halifax will be useful:

The plant in question is a stereo metal melting furnace of 3 tons capacity, originally coke fired but converted to gas on the surface principle of firing in August, 1924.

The average output of castings is 45 cwt. per 8-hour day.

The furnace is held at 450° F. during the remaining 18 hours per day by means of an auxiliary atmospheric burner. The furnace has worked in this manner since the conversion to gas and no replacements or alterations were made until the test figures had been taken.

It was claimed by our competitors that if the furnace was converted to oil the annual running costs would be £98, against £200 for gas. The figure given for gas was computed by our competitors.

The cost of conversion to oil, including storage tanks, &c., was estimated at £400. The figure given for gas represented an annual consumption of 2,400,000 c.ft. This figure was almost twice as high as our calculated figures.

It was therefore decided to install a test meter and take readings over a period of one month. The result was as follows:

Consumption of gas, 116,500 c.ft.
Price of gas, 5d. per therm = £114 6s. 2d. per annum.
1,371,700 c.ft. per annum.
The furnace is still gas fired.

Bakers' Ovens.

The heating of a baker's oven of the steam tube type represents another opening for the industrial gas engineer. There are many large installations operating on gas, but these in most cases have been wholly designed to operate on gas. The conversion of existing coke-fired ovens presents a problem because the running costs must be extremely low. With gas at 3·5d. per therm, conversion to the Brun gas system of heating is a good proposition for bakers, but it is not possible for many undertakings to supply gas at such a low figure. An increase in efficiency is therefore necessary if the use of gas is to be developed in this direction.

The two obvious ways of increasing efficiency are (1) by increased insulation, (2) by either regeneration or recuperation.

We arranged with one of our largest local bakers to convert a double decker oven 8 ft. by 6 ft. to gas.

The Brun gas system of firing was utilized, but the waste-gas flues were altered to enable recuperators for the secondary air to be introduced. Two-inch steam tubing was used for the recuperators.

A 3-in. course of " Fos-al-Sil " insulating brick was built round the oven and firebox.

The damper in the main waste-gas flue was marked to correspond with the amount of gas passed through the main gas valve, and thus the amount of excess air allowed to enter the furnace was maintained at a minimum.

Analysis of the waste gases shows a low percentage of free oxygen and a high percentage of CO_2.

This oven is to remain on test for six months, and as the conversion was only completed on Jan. 12 this year reliable figures are not yet available.

The following, however, are the comparative costs over the first week's running:

Coke at 25s. per ton delivered, including stoking, ash removal, &c., £1.
Gas at 5·75d. per therm, £1 10s. 8d.

Morris-Commercial "Silent-Third" Trucks

The Morris-Commercial policy is to endeavour to produce the best vehicles at the lowest cost, and pass on the benefits of big output to the actual user.

After producing over 40,000 Morris-Commercial 1-ton and 15-cwt. vehicles, the manufacturers find it possible to increase the efficiency of these popular models by adding extra features, including four-speed gearbox with "silent third," and four-wheel brakes. This has been done without increasing the prices, and there is no doubt that the new models offer remarkable value.

They are claimed to be particularly economical on petrol and oil, which is a big consideration in these days of increased fuel costs. The tonner, with full load, under ordinary conditions, will run as much as 20 miles on a gallon of petrol and the 15-cwt. up to 22 miles to the gallon. The new gearbox allows for extra speed and even better hill-climbing performance, while safe driving is ensured by powerful four-wheel brakes.

The equipment includes a 12-volt battery, dipping beam headlights, chromium plated radiator; also spare wheel and tyre, starter, electric horn, mirror, speedometer, tyre pump, and full set of tools.

1933 Morris-Commercial 1-Ton Truck and Van.

The standard 1-ton truck costs only £198 complete, while a van can be bought for £212. The 15-cwt. van is priced at £195. The manufacturers—Messrs. Morris Commercial Cars, Ltd., of Adderley Park, Birmingham—will be pleased to send catalogues to any persons interested in these new vehicles.

THE "JOURNAL" TECHNICAL RECORD

Which contains Reports of Meetings of Gas and Allied Associations

Production of Organic Compounds from Coke Oven Gas*

By J. W. Osterrieth and Georges Dechamps.

Coke oven gas became valuable with the introduction of the synthetic ammonia process. As gas obtained from the carbonization of coal at high temperature contains 50 to 60% of hydrogen, it is a source of hydrogen which has been tapped by the pioneers of the synthetic ammonia industry. Realizing the potentialities in this direction, Georges Claude in France and Linde in Germany developed industrial plants for the extraction of hydrogen from coke oven gas by liquefaction and subsequent fractionation. The design of the plant, in which temperatures of more than 200° C. below zero are obtained, is based on simple physical principles, particularly the absorption of heat through the evaporation of a liquid or the expansion of a gas accompanied by the production of external work. The plant of the Société l'Air Liquide (Procédés Georges Claude) consists essentially of a nest of tubes in which compressed coke oven gas is cooled in contact with gas expanded after fractionation. As the compressed gas cools, condensates are formed at certain points. First, the liquefaction of ethylene and similar products occurs. After that gases are liquefied which consist principally of methane, and finally gases rich in carbon monoxide and nitrogen are obtained. The evaporation of these liquids at low pressure cools the coke oven gas sufficiently to condense the heaviest constituents, so that ultimately only hydrogen, containing a little carbon monoxide and nitrogen, remains in the gaseous phase. It is sufficient to wash the hydrogen with liquid nitrogen, as first demonstrated by Prof. Maxted, of Cambridge University, to remove the remaining carbon monoxide. The purified hydrogen passes to an expansion engine driving a compressor, after which it is heated again to atmospheric temperatures by the compressed coke oven gas in the liquefaction plant.

At first the expanded gases, other than hydrogen, were returned through one and the same pipeline as rich gas, which was only valued on a calorific power basis. With the perfection of the liquefaction plants, gases were obtained as bye-products whose composition made them eminently suitable for the synthesis of compounds other than ammonia. A plant of the Société l'Air Liquide of an hourly capacity of 10,000 cub.m. (350,000 c.ft.) of purified coke oven gas (61% H_2, 24% CH_4, 2% C_nH_{2n} and 5% CO) produces simultaneously:

6200 cub.m. (218,500 c.ft.) H_2, containing 11% of N_2;

125 cub.m. (4410 c.ft.) of gas rich in carbon monoxide, containing 33% CO, 40% N_2, 10% CH_4, 17% $H_2 + O_2$.

3850 cub.m. (135,700 c.ft.) of gas containing 60% CH_4, 13% H_2, 12% CO, and 2% of other gases.

250 cub.m. (8820 c.ft.) of gas rich in ethylene, containing 60% of olefines and 35% of C_2H_4.

As the above-mentioned gases are derived from coke oven gas which has undergone preliminary purification, they are free from sulphur and other impurities, which may be harmful to catalysts. As they are eminently suitable as raw materials for the synthesis of organic products, work undertaken on these gases led to the development of new manufacturing processes using somewhat impure raw materials.

Utilization of Carbon Monoxide in the Synthesis of Methanol.

Carbon monoxide and hydrogen are the raw materials for the synthesis of methyl alcohol, or methanol, which is formed according to the equation:

$$CO + 2H_2 = CH_3OH.$$

This reaction, as in the synthesis of ammonia, is accompanied by a reduction in volume, which, however, is here even greater than in the case of ammonia, and is, therefore, favoured by high gas pressures according to the principles of Van't Hoff and le Chatelier.

In industry, high-pressure gas reactions are carried out in specially designed containers, charged with the catalyst, which are enclosed in externally or internally heated tubes capable of withstanding pressures varying from 100 to 1000 atmospheres (1470 lbs. to 16,170 lbs. per sq. in.), according to the process. The gas for the synthesis has a definite composition and circulates in the reaction tubes at the required temperature and pressure. Up to this point all the different processes are the same, but differ from here in various aspects.

In certain processes, the gases remaining uncombined after the reaction are re-circulated with the addition of fresh gas over the catalyst. In other processes, such as that of Claude, the circulation pump can generally be dispensed with. The gaseous mixture only passes once over the same catalyst, which, however, is placed in a number of reaction tubes arranged in series with intermittent condensers and separators.

The use of a circulating pump permits the complete utilization of the gas prepared for the synthesis. The recirculation, of course, entails some costs, but these scarcely exceed 10% of the total cost of compression. On the other hand, the composition of the gaseous mixture must be correctly adjusted, so that the gases passing over the catalyst always possess the required theoretical composition—for instance, in the synthesis of ammonia, 25% N_2 and 75° H_2. It is also necessary to reduce the inert gases not utilized in the synthesis to a minimum, because re-circulation of these gases would rapidly increase their concentration and would soon put an end to the process by causing serious difficulties in the synthesis. In a synthesis with an open circuit, on the other hand, much greater latitude is possible in the composition of the gases and also in their content of inert impurities. In each of the reaction tubes the synthesis takes place under different conditions, and it need not even be the same synthesis in the successive tubes. This fact permits the first tube to be used as a purifier, in order to bring about the following reactions:

$$CO + 3H_2 = CH_4 + H_2O.$$
$$O + 2H_2 = 2H_2O.$$

It is evident that in order to obtain good yields and in order to avoid the use of an excessive number of reaction tubes in series, it is necessary to operate under suitable conditions and at high pressures. Consequently, the composition of the gaseous mixture must be so adjusted that all its constituents combine in the course of the synthesis and that no compressed gas is lost. For this reason the following facts must be borne in mind, when it is contemplated to use a gas rich in CO, as obtained from the hydrogen plant, for the synthesis of methanol:

(1) For the synthesis a process with open circuit must be chosen, because of the nitrogen which accompanies the carbon monoxide.

(2) The gas must be enriched with hydrogen, so that its composition corresponds to $CO + 2H_2$ according to theory.

(3) Much of the nitrogen is uselessly compressed.

The conclusion, therefore, must be drawn that, in order to utilize the gas in question to the best advantage, it should be treated by a process with an open circuit, consisting of the successive syntheses of methanol and ammonia.

In order to obtain a gaseous mixture with its constituents in equilibrium, the gas rich in carbon monoxide coming from the hydrogen plant must be diluted with at least three times its volume of hydrogen. The mixture has then the following composition:

8% CO; 18% N_2; 71·5% H_2; and 2·5% CH_4.

From 10,000 cub.m. (350,000 c.ft.) of coke oven gas treated 500 cub.m. (17,650 c.ft.) of this mixture is obtained; 5800 cub.m. (208,750 c.ft.) of hydrogen remain for the synthesis of ammonia by the usual process.

Under these conditions, about 45 kg. (99 lbs.) of methyl alcohol can be produced. The efficiency of converting carbon monoxide into methyl alcohol is of the order of 80%, the unconverted carbon monoxide being transformed

* Paper before the Institute of Fuel, Jan. 11, 1933.

into methane in the purifier tube, preceding the synthesis of ammonia.

The practical execution of this synthesis suffers from certain drawbacks, inasmuch as, besides the principal ammonia process, a small compressor and additional plant are required, which on account of its relatively low output is not very economical.

To reduce costs, a mixture with a lower content of CO is used, such as is obtained from the hydrogen plant, a gas not washed with nitrogen and still relatively rich in carbon monoxide. The whole of this gas is used for the synthesis of methanol, after which it goes to the ammonia process. The gas then contains 3 to 5% of carbon monoxide. This method of working has been adopted by the Compagnie de Bethune in France, and du Pont de Nemours in the United States.

Conversion of Methane.

To produce methane in greater quantities, it is possible to draw on other sources for carbon monoxide and hydrogen. The synthesis can be carried out with water gas, as practised by the Société Franco-Belge d'Ougrée at their works at Bully les Mines (France). If one starts, however, from coke oven gas, it is necessary to convert the methane, the largest constituent in this gas next to hydrogen, into carbon monoxide and hydrogen.

It is well known that when methane is exposed to high temperatures it is cracked and yields hydrogen. According to operating conditions, the carbon of the methane can be partly or totally de-hydrogenated. In the first case, unsaturated and benzenoid hydrocarbons are obtained; in the second, finely divided carbon is produced, as in the production of lamp black. If hydrogen or gases for high-pressure syntheses are the objective, the liberated carbon must be oxidized with the view to forming carbon monoxide or carbon dioxide, whereby, incidentally, blockages through soot are avoided.

If the oxygen for the process is obtained from air, the following reactions take place:

$$\left.\begin{array}{l} 2CH_4 + O_2 + 4N_2 = 2CO + 4N_2 + 4H_2 \\ \text{or } CH_4 + O_2 + 4N_2 = CO_2 + 4N_2 + 2H_2 \end{array}\right\} \quad (1)$$

These reactions are exothermic and cannot be used unless advantage can be taken of the nitrogen in the resulting gaseous mixture (ammonia synthesis).

The oxygen can also be furnished by steam, in which case the reactions are expressed by the following equations:

$$\left.\begin{array}{l} CH_4 + H_2O = CO + 3H_2 \\ \text{or } CH_4 + 2H_2O = CO_2 + 4H_2 \end{array}\right\} \quad (2)$$

These reactions are endothermic and require elevated temperatures, but give an excess of hydrogen.

Lastly, pure oxygen can be used, produced either by liquefaction or by electrolysis. The process is then represented by the following equations:

$$\left.\begin{array}{l} 2CH_4 + O_2 = 2CO + 4H_2 \\ \text{or } CH_4 + O_2 = CO_2 + 2H_2 \end{array}\right\} \quad (3)$$

These reactions are exothermic and generally costly, on account of the price of pure oxygen. Installations for the ammonia synthesis, however, often possess plant for the liquefaction of air, for the production of nitrogen, which yields a certain amount of oxygen as bye-product.

In practice, the different reactions for the conversion of the methane are combined in order to obtain a gas of the desired composition. Reactions (2) are particularly interesting from an industrial point of view, but they necessitate temperatures often exceeding 1200° C. In actual practice certain catalysts generally containing a nickel base, are employed, which allow of operation at lower temperatures in the neighbourhood of 800° C.

Industrial Installations.

In industry, several ways have been adopted. The Gesellschaft für Kohlentechnik at Dortmund-Ewing has made the production of pure hydrogen its main objective, and incidentally obtains a mixture of hydrogen and nitrogen ($3H_2 + N_2$) for ammonia synthesis. The process developed by this concern converts all the methane with water vapour, any CO formed being converted into CO_2, which is removed by absorption. In practice, excess of oxygen is always necessary, and pure oxygen is used when pure hydrogen is to be obtained. Air is employed when it is intended to produce a mixture for the ammonia synthesis. Purified coke oven gas is taken as raw material, in order to obtain mixtures richer in hydrogen.

Other companies, such as the Société Courrieres-Kulhlmann, have had the synthesis of methanol in view and produce a mixture of 33% CO and 66% H_2. Here coke oven gas also serves as raw material, the conversion being effected according to the equation:

$$CH_4 + H_2O = CO + 3H_2.$$

The Société d'Ougrée-Marihaye has aimed to produce as economically as possible a gas which would be suitable for the successive synthesis of methanol and ammonia. At first a gas rich in methane, obtained from the hydrogen plant, was used; later purified coke oven gas was taken, so that the liquefaction could be dispensed with.

The aim at Ougrée was to produce a gas with correct chemical proportions having a carbon monoxide content of about 12%. Several reasons demand this composition. In the first place, the desire to obtain an appreciable yield of methanol, without causing the production of ammonia to suffer; in the second place, the fact that the higher the concentration of carbon monoxide the lower the nitrogen content, and consequently the greater the addition of oxygen to the air used. It must also be remembered that the synthesis of methanol is facilitated by a large excess of hydrogen in relation to the monoxide present. It is known that at equilibrium the concentration of methanol is proportional to the square of the concentration of hydrogen and only equal to the first power of the concentration of carbon monoxide, a fact which leads to the use of an excess of hydrogen, in order to ensure a high rate of conversion. As the reaction is strongly exothermic, an excess of inert gases facilitates the removal of the heat liberated and eliminates side reactions and other drawbacks caused by the packing of the tubes.

The cracking plant is very simple. It consists essentially of a reaction chamber made of firebricks, where the purified and preheated coke oven gas, with a small addition of water vapour, is oxidized with superheated air charged with oxygen, coming from a high-temperature metal heat exchanger. As the gas still contains some methane at the outlet of the reaction chamber, it passes over a suitable catalyst when still at a high temperature, whereby the conversion is completed. After passage through the heat interchanger the gas is scrubbed and stored in a holder. As a result of the catalyst employed, it is possible to reduce the reaction temperatures to about 800° C., so that heat interchangers constructed of special metal can be used, which work continuously and eliminate completely the risk of explosion. The plant functions perfectly and works for more than 1000 hours without requiring inspection or replacement of the catalyst. It is worth noting that the process of the Société d'Ougrée-Marihaye produces a cracked gas, entirely free from small carbon particles, which can be used immediately for the synthesis. The gas contains less than 1% of CH_4 and a quantity of CO, easily adjusted by the addition of a small supplementary plant, which converts all or part of the CO into CO_2, so that the same plant can be used for the production of gas ($N_2 + 3H_2$) for the ammonia synthesis. The removal of the carbon dioxide takes place in the main compressor plant, between two stages of the final compressors. The residual gas from the synthesis returns to the cracking chambers and is used again.

With a gas of this nature available, production of methanol and ammonia in series could be undertaken in open circuit, giving yields of 80% with regard to the conversion both of CO into CH_3OH and N_2 into NH_3. The gas for the synthesis is produced at a lower cost than the mixtures obtained by liquefaction, and when taking the ammonia produced at its normal net value, the methanol is obtained at a remarkably low price.

Owing to the flexibility of the process described, it is possible to prepare gaseous mixtures equally suitable for the synthesis of ammonia or of methanol alone.

Other Methane Derivatives.

Up to the present, the conversion of CO and CH_4 into alcohol and more particularly into methyl alcohol has been considered. In actual practice, several higher alcohols (propyl and isobutyl) are produced simultaneously with methanol, but the quantity obtained does not exceed 10% of the total alcohol produced.

Other syntheses can be visualized using methane as the primary material. In laboratories, particularly in Germany, the chemical value of these gases has been studied from the point of view of producing gaseous or liquid hydrocarbons. Up to the present, however, the researches have not led to any practical application. Among the different products which have been obtained by the chemist from methane, acetylene is particularly interesting, because of its numerous practical applications and the chemical derivatives to which it leads. The known methods for the conversion of methane into acetylene can be classed into three categories—namely, (1) methods employing an electric arc, (2) those using an electric discharge, and (3) purely thermal processes.

The electric processes capable of industrial application must produce acetylene, with an expenditure of electric energy less than that required for the manufacture of the corresponding amount of calcium carbide. The calcium carbide industry has been brought to such perfection that to-day 1 kg. of carbide consumes less than 3·5 kw.h. (1·5 kw.h. per lb.), which corresponds to 12·6 kw.h. per cub.m. (0·357 kw.h. per c.ft.) of acetylene.

The process employing an electric discharge reaches approximately this figure, but it requires a vacuum of the order of 0·05 atmosphere (0·735 lb. per sq. in.) and a com-

plicated plant. Altogether, the superiority of the carbide process does not justify the creation of a new industry.

The thermal process, on the other hand, has a claim to industrial application, and it is surprising that it has taken so long before its industrial realization has been attained.

> The conversion of methane into acetylene is best carried out at temperatures ranging from 1200° C. to 1500° C., and unless suitable means are adopted all the acetylene produced at these temperatures is de-hydrogenated down to the stage of carbon.

Hence, two great technical difficulties have to be overcome —namely, the instantaneous production of high temperatures, and the rapid cooling of the gas after the reaction. The Société Franco-Belge d'Ougrée has solved the problem in the following manner:

The gas rich in methane is preheated to a temperature of 800° C. in the presence of water vapour, before being admitted to the reaction chamber. The part played by the water vapour is that of preventing the formation of carbon during both the preheating stage and the pyrolosis. The high instantaneous temperatures which are necessary for the conversion of methane into acetylene are obtained by the injection of a predetermined quantity of oxygen into the reaction chamber, where it combines with a part of the methane, forming CO_2 and CO. Under these conditions the process operates with the volumetric velocity to the order of 100,000, so that at a temperature of about 1600° C., a gas up to 8% of acetylene is obtained. From 35 to 40% of the methane is thus converted into acetylene, and practically the whole of the remaining methane is converted into carbon dioxide, carbon monoxide, and hydrogen. After the extraction of acetylene and carbon monoxide by the usual methods a gas is available which can be used directly for the synthesis of methanol.

In the practical application of the process, serious difficulties had to be overcome, arising from the high temperatures used. Heat interchangers and reaction chambers had to be constructed of suitable material, and systematic studies on the subject had to be undertaken. Modern technique, however, provides means for overcoming all such obstacles. Industry to-day is in a position to supply the special steels and refractory materials for this new process.

Utilization of Gas Rich in Ethylene.

More than a century ago, an English chemist, Henry Hennell, showed that olefines can be absorbed by sulphuric acid, forming esters, which can be converted into alcohols or ethers by saponification. In recent years, the chemical industry has employed these reactions for the production of ethyl-alcohol.

It is surprising that it has taken such a long time before the laboratory experiments have been put into practice, but it must be remembered that the industry of chemical synthesis cannot develop by itself. It requires the assistance of other branches of industrial activity, and the progress made, for instance, in metallurgy or refractories or in the realm of electricity opens new possibilities for the synthetic chemical industry. What is still true to-day in the case of synthetic processes using acetylene has applied in the past to the synthesis of alcohol. It had to wait for the completion of other tasks. In particular the economic production of ethyl-alcohol depended on the disposal of concentrated sulphuric acid at a reasonable price. This only became possible after the development and perfection of the contact process for the manufacture of sulphuric acid.

The industrial application of the process has not suffered from great intrinsic difficulties. The absorption efficiency, the prevention of pitch formation, the regulation of temperatures, &c., have been the object of detailed studies by the Compagnie de Béthune in France, which can claim the honour for having made the process a practical proposition.

The process such as it exists in practice consists of three successive operations. In the first place, there is the absorption of the gas, which is compressed at 10 atmospheres (147 lbs. per sq. in.), and washed in a series of towers with concentrated sulphuric acid maintained at a predetermined temperature, through a special device. The second stage is the saponification of the ethyl-hydrogen sulphate. After dilution with a certain quantity of water and the separation of pitch, it is admitted to a lead plate column heated with live steam. The regenerated sulphuric acid leaves the still at the bottom, while the alcohol vapour escapes at the top and enters the condenser after having passed a neutralizing column. The third operation is the rectification of the alcohol.

In the installation erected at Ougrée (Belgium) the efficiency of the absorption of olefines exceeds 95%, so that about 1 litre of concentrated acid is consumed per 1 litre of alcohol produced. After the saponification of the alkyl hydrogen-sulphate, the resultant dilute acid is used in the manufacture of ammonium sulphate. The alcohol produced has a strength of more than 50° G.L., but it unfortunately contains oil impurities and appreciable quantities of isopropyl alcohol and ethers. In order to produce rectified spirit, it is necessary to treat the crude product by special processes. At Ougrée the rectification is based on nitration processes developed by the Société des Distilleries des Deux-Sevres. This rectification produces rectified spirit and absolute alcohol. The ether is collected separately and converted into a commercial product by a second rectification.

It must be noted that it is practically impossible to separate completely isopropyl alcohol from ethyl alcohol. If pure ethyl alcohol is to be obtained, the propylene must be separated from the ethylene before the latter is absorbed in sulphuric acid. The process started by the Société d'Ougrée-Marihaye consists of the selective absorption of propylene in the first scrubbing tower, kept at a low temperature and fed with sulphuric acid already containing a definite amount of ethyl hydrogen sulphate. The alkyl hydrogen-sulphates extracted from the first tower are complex products, which give, on saponification, vapours rich in isopropyl alcohol. The final treatment of these vapours presents a difficult problem, because the isopropyl alcohol is still accompanied by ethyl alcohol, ether, and different impurities. It occurred to the Société d'Ougrée-Marihaye to utilize these vapours for the synthesis of acetone. The attempt has been entirely successful, owing to the discovery of polymetal catalysts which are particularly stable at the relatively low temperatures employed, so that the products resulting from the saponification can be used without any final purification.

The operation consists of a simple conversion carried out at about 400° C., in the vapour phase. The principal reaction is represented by the equation:

$$2CH_3.CHOH.CH_3 = 2CH_3.CO.CH_3 + H_2.$$

A certain portion of the ethyl alcohol is also converted into acetone according to the equation:

$$2CH_3.CH_2OH + 2H_2O = CH_3.CO.CH_3 + CO_2 + 4H2.$$

After the condensation of the vapours and the separation of the gas formed by the reaction, a liquor with a rather low acetone content is obtained, which also contains dimethyl-acetone, ether, ethyl alcohol, and acetaldehyde, apart from different ketons and other substances.

The distillation of these somewhat complex products would appear to be rather difficult, but is carried out in one operation, which produces direct acetone B.G.S. The efficiency of converting alcohol into acetone as carried out at Ougrée is over 80%.

It is noteworthy that the synthesis of acetone can also be carried out with gas rich in acetylene obtained by the pyrolysis of methane, to which reference has been made previously.

Other Products.

In the above paragraphs only organic products have been discussed which can be extracted by present-day technical processes from coke oven gas, and in particular from fractions obtained in the course of the liquefaction of this gas when used for the ammonia synthesis. There are other products, of course, such as ethylene-glycol, ethyl chloride, ethanolamines, &c., which, up to the present, have been manufactured from other raw materials.

Already, however, with basic products such as methanol, acetylene, ethyl alcohol, and acetone, the field of organic synthesis becomes almost unlimited. Methanol is converted into formol (formaldehyde) and its derivatives, trioxy-methylene, hexa-methylene-tetramine, synthetic resins, &c. From acetylene can be produced, apart from acetone, acetaldehyde, metaldehyde, acetic acid, and various acetate solvents. Acetone can be re-hydrogenated to isopropyl alcohol or converted into diaceto-alcohol and other solvents. There are no limits to manufacturing processes except the ever-rising costs through the successive operations and the cumulative effect of individual process efficiencies.

There comes a point when it is more economical to let bacteria and plant life do in one operation and within a restricted compass what man only achieves in several stages and in complicated plant. To make chemical synthesis successful, the raw material must be obtainable at a low price, and production must be on the larger scale. Then important markets for the products must be found. Their use as fuels suggests itself as the most natural outlet. Alcohols, in spite of their low calorific value, have anti-detonating properties and prevent carbon deposits, characteristics which are not common to ordinary motor spirit. If synthetic alcohols cannot be produced at a price equal to that of petrol, they can still be marketed below the selling price of the latter in most countries, where there is a heavy tax. Apart from the question of agricultural subsidies or the protection of a national industry, it is possible to-day to consider the use of alcohols as a means of improving motor spirit. The authors do not propose to

deal with this aspect in detail, which is being studied extensively in most countries producing alcohol, but they would like to point out that, although the properties of alcohol-petrol mixtures have been studied, very little is known with regard to mixtures of petrol and methanol. The latter does not mix readily with petrol, so that it is necessary to add other solvents.

Methanol has interesting properties as motor spirit, which are being studied at this moment. Experiments on the test bench have shown that the burning properties and the relative consumption of blended motor fuel improves with an increasing content of methanol in the mixture.

As much remains still to be done in the fuel field, it is regrettable that at times petroleum technologists should be in combat with their colleagues of the alcohol industry. Perhaps technologists of chemical synthesis will bring about a reconciliation of the two sides. Besides, gas chemistry is a field where coal and petroleum technologists are obliged to meet. Methane and ethylene are not monopolies of one industry. The chemistry of coal, because of its great age, is doubtless more highly developed than that of the sister industry, but this should be an additional reason for fuel technologists to work together for progress and the general good.

Discussion.

The CHAIRMAN (Prof. G. T. Morgan), after congratulating M. Osterrieth, asked for information concerning the nature of the catalysts which had been used in the various chemical processes. Those concerned with the high-pressure work at the National Physical Laboratory at Teddington had had to work with pure carbon monoxide and pure hydrogen, and had used the Patart catalyst. Where the zinc chromite reagent was used, one obtained a very large conversion of carbon monoxide into methyl alcohol—about 99%—and little or no methane; but when that catalyst was mixed with another, which might be a cobalt chromite, or another catalyst containing iron, although there was a complex mixture of alcohols, including ethyl alcohol, this formation of ethyl alcohol was nearly always accompanied by considerable quantities of methane. In the experiments described in the paper the sulphur was disposed of at the outset, but even the sulphur in the gas could be used, under certain conditions, as the basis for producing some organic products, among which he suggested thiourea, synthetic resins, and so forth.

Dr. G. W. ANDERSON said that the Claude process lent itself most admirably to the production of ammonia on a comparatively small scale. The works with which M. Osterrieth was connected turned out about 150,000 tons of ammonium sulphate, or 30,000 tons of ammonia (which was the equivalent) per annum. But the units were sufficiently small to come within the compass of medium size coke oven batteries of, say, 60 ovens. The Société l'Air Liquide, which exploited the Claude processes abroad, provided units for 5, 15, and 35 tons of ammonia per day respectively. A battery of from 60 to 100 ovens would be quite capable of running a process of synthesis, not necessarily ammonia synthesis, economically, and when one saw the compactness and smallness of the plant used for this production one would realize that the Claude process had much in its favour. Dr. Anderson drew attention to the method of purification adopted as final purification of the gases after compression. The gases were subjected to a pressure of 20 atmospheres, or 300 lbs. per sq. in., and passed through a series of towers. The first vessel extracted benzole, the following carbon dioxide and hydrogen sulphide, then ammonia was extracted by water, scrubbing followed, and finally there was a series of drying towers in which caustic soda was used. It might be argued that the process was expensive, but in many cases, as gas was distributed to-day at high pressure, it might be worth considering the compression of gases, after some preliminary purification, for the purpose of subjecting them to the final purifying process as practised in gas undertakings to-day. That would be an entirely new phase. It would also bring within the scope of gas undertakings the use of pressure gasholders, which were popular in Switzerland.

Dr. NEWITT (Imperial College of Science) said he would have been glad to have had figures representing the efficiency of the processes.

SIMULTANEOUS PRODUCTION OF METHANOL AND AMMONIA.

Dr. W. R. ORMANDY asked what price of coke oven gas was taken into the calculation on which was based the statement that the bodies produced by the methods described in the paper were capable of economic competition with similar bodies produced by other methods. It was possible to vary the methanol/ammonia ratio between comparatively wide limits, but the essence of the process described in the paper was the simultaneous production, in one operation, of methanol and ammonia, and, unfortunately, both products were a drug on the market. He could not imagine what the feelings of I.C.I. would be if all the coke oven owners began to produce methanol, with a plant capacity to produce five times as much as there was a demand for. It would be necessary to convince the steelworks owners that the costs of the processes described were competitive before similar plants would be put up in this country. He was interested most in the part of the paper dealing with the conversion of ethylene, propylene, and butylene into the corresponding alcohols by means of a process which he ventured to submit would shortly be antiquated—*i.e.*, the utilization of sulphuric acid. It was a process which was, of course, economic and capable of being used in any place where it was not necessary to re-concentrate the sulphuric acid, but to venture to start a plant the object of which was to produce methanol and ethanol and the higher alcohols, and then to have to build an ammonia plant big enough to use the sulphuric acid, would not appeal to most chemical engineers, he believed. In fact, there had been evolved processes whereby these unsaturated bodies were converted catalytically in the dry state into the corresponding alcohols, the yields being sufficiently high to justify the statement that the life of the sulphuric acid processes was limited. With regard to the authors' suggestion that there should be harmony and peace between the alcohol and petrol producers, that was asking a good deal of the petrol producers, who had more petrol than they knew what to do with, and who were willing to sell it at 4d. per gallon delivered alongside. To build up a chemical reaction based on the difference between the economic cost of production and the price at which it was sold (owing to the desire of a Government to get hold of all the money it could lay hands on) did not seem to him to be an economic proposition. The suggestion was made that, as methanol was one of the products which it was said could be produced economically along with ammonia, methanol should be used in conjunction with petrol, where it had certain advantages. Unfortunately, however, methanol did not mix with petrol, and it was necessary to add another ingredient in order to bring it into admixture; the best ingredient for that purpose was amyl alcohol. If the active and progressive people on the Continent would turn their attention to the production of the higher alcohols, then they would be able to claim that they had really good prospects of improving the quality of motor spirit, and so arouse the interest of the petroleum people.

Mr. F. S. TOWNEND asked whether the coke oven gas must be purified, as regards H_2S, to the degree that was necessary in the case of town gas in this country. As to the possible application to the coke oven industry of the processes described in the paper, he urged that it was essential for any such processes to yield a further credit to the coke oven plant, and he asked how much extra credit the application of these processes would give to the coke oven plants, and whether that credit would be greater than could be obtained in this country for coke oven gas sold for distribution for town purposes.

UNWISE TO STOP PROGRESS.

Dr. R. LESSING said that, knowing the reputation of the Company with which M. Osterrieth was associated, they might fairly leave it to them to take care of the economic side of their own business. On the technical side, they had to consider that the work which had been done by the Ougrée Company on the Continent, by the I.C.I. in this country, and by a number of other and smaller concerns in other countries, had definitely shown that in a very short time it was possible to create an entirely new aspect of one particular phase of industry. All this work was started only after the war—apart from the work of the I.G. (which was just commencing when the war broke out) on ammonia synthesis—so that within a very short time it had been found possible to work out a technique entirely different from anything known before, and to prove that by working at high pressures it was possible to manipulate materials with the greatest ease, and, in fact, with greater facility than that with which it was possible to manipulate gases under ordinary pressure. Until these processes had become the vogue a great many inventors had claimed that it was of the greatest advantage for any process to be worked at little above atmospheric pressure. It had been proved in practice, however, that nothing was easier than to carry out these high-pressure reactions, at least where great quantities of gases had to be dealt with. So that they had an entirely new phase of chemical engineering and chemical industry. It had been shown by the paper that the reactions referred to could be handled in a number of directions, and the possibilities seemed enormous. It was hardly right to apply the measuring stick of present-day economics, and say that under present conditions, with petrol cheap, there was no chance of competing with natural oil supplies. He believed that uses would be found for these products as readily as the processes for their production had been discovered. At the moment they happened to have reached a phase of world economics at which we were suffering from a glut of practically everything, but it would be rather a weak-minded policy to stop progress for that reason, and not to carry on in spheres of which they knew relatively little.

Mr. O. W. ROSKILL, discussing the economics of the problem, said that to his knowledge there were only five plants making synthetic methanol or alcohols from coke oven gas at the present time, out of a total of forty plants making synthetic nitrogen from coke oven gas. There were two reasons for this. In the first place, by far the greater part of the world output of synthetic methanol, for instance, was made from water gas—probably between 65 and 75%. It should be remembered that practically every nitrogen plant had a considerable proportion of surplus capacity, and the ease with which methanol could be produced instead of ammonia in an ordinary Haber-Bosch converter from water gas made the latter a very favourably placed competitor of coke oven gas, since extra capital expenditure was needed for the production of methanol in a coke oven gas nitrogen plant. In the second place, the markets for these organic products were at the moment very limited. Methanol was perhaps in the best position, since the growing output of synthetic resins had maintained a strong demand for formaldehyde. But the oxidation of methanol to formaldehyde was by no means so simple a process as might appear, and considerable difficulties had been experienced in Bethune. The position as regards ethyl alcohol was often governed more by political than economic considerations. At the moment, un-

doubtedly, the most hopeful line lay in the manufacture of acetone and other secondary products, as was being done at Ougrée, but it would be interesting to know whether the Belgian market could absorb the entire Ougrée output if the plant were worked to capacity, let alone any produced by the eight other nitrogen plants.

As to the use of alcohol in motor fuel mixtures, he had estimated that some 20 million gallons were used throughout the world in this way, compared with a petrol consumption over 1000 times greater. But the compulsory mixing regulations on which the use of alcohol was based were designed to help agriculture, and in most European countries there would be no difficulty in producing alcohol up to 20% of the petrol consumption, from vegetable raw materials. He asked whether either alcohol or methanol from coke oven gas could compete for fuel purposes as regards cost of production, even with the benefit of the high duty on petrol imposed in most European countries, when the low calorific value was taken into account. One gallon of methanol, for instance, was equivalent to less than two-thirds of a gallon of petrol on a mileage basis. At the same time, there appeared to be some hope of selling methanol at a premium on account of its anti-knock value.

Finally, in submitting that the technical achievements were severely limited by the economic possibilities, he said that at Béthune there was a rough relationship, for instance, between the output of synthetic ammonia and that of methanol, as would be expected. Normally, the output of methanol was about 10% of that of ammonia. The world capacity of coke oven gas nitrogen plants might be estimated as about 600,000 tons of ammonia per year, and it was very doubtful that it would be possible to find a market for 60,000 tons of coke oven gas methanol per year over and above the output from water gas ammonia plants such as Leuna and the harassed remnants of the wood distillation industry.

Dr. HOWES took serious objection to the statement in the paper that experiments on the test bench had shown that the burning properties and the relative consumption of blended motor fuel improved with an increasing content of methanol in the mixture. It was not so. As to the anti-knock value of alcohols, he said the same increase in anti-knock value could be obtained with tetra-ethyl-lead, and very likely at much reduced cost. The advantage of alcohols in removing carbon deposits from an engine was questionable. Further, he did not believe that the economic production of alcohol had been demonstrated beyond question; and the addition of alcohol to any petroleum spirit conferred a large measure of physical instability to the mixture, which instability could not very well be overcome.

Dr. FOXWELL, discussing the price of coke oven gas, said it had been stated that the coke oven people would accept 5½d. It should be borne in mind, however, that there were old plants in the country which would have to be re-built, and in the case of a re-built plant, even of fairly large size, it would be necessary to secure a price of something like 7½d. With a very large plant perhaps it would pay to sell about 6d., but, at any rate, an economic price was something more than 5½d. It was necessary to find further outlets for surplus coke oven gas, and if the processes described in the paper were not economic, then others must be found. In this connection he mentioned a recent paper in which it was shown that, given correct temperature and time of contact, the methane in the coke oven gas could be converted directly into benzene. He suggested that Prof. Morgan might with advantage carry out experiments at Teddington with a view to discovering economic uses for coke oven gas.

M. OSTERRIETH, replying to the discussion, said that the catalysts used for the synthesis of methanol at Ougrée were of the chromite-zinc types; those used for the synthesis of CO and H_2 from methane were of the nickel type, activated with rare earths. The last catalysts spoken of, for acetone, were of the salt type, salts of iron and alkaline earths, which were resistant to high temperatures, and were also activated with metals of the rare earth series. He could not discuss the economic aspects of the problem extensively at this stage, but, dealing with the question as to the price of coke oven gas, he said it was found that the B.Th.U. in the gas was about twice as expensive as the B.Th.U. in coal. He appreciated that mixtures of alcohol and petrol were difficult to make. They had been studied quite a lot, however; the mixtures were quite remarkable, and the consumption per mile was not greater than with petrol, with alcohol up to 20%. Methanol alone could be used in motor cars, and the consumption was only 1½ times as much as petrol consumption.

Mr. J. F. RONCA (Director of Gas Administration, Board of Trade) asked if it were used in a special engine, having a higher compression.

M. OSTERRIETH replied that it was used in the usual kind of engine, the only difference being in the sparking arrangements.

Gas Rates*

By G. W. WOODBRIDGE.

In New South Wales the lack of development in methods of charge has been without doubt largely attributable to statutory restrictions. These, however, have now been removed by the recently enacted Gas and Electricity Act, 1932, which under section 42 provides that a company may with the approval of the Minister, after inquiry by the Commission—

(*a*) require guarantees of a specified annual consumption or a specified annual revenue, or make a special charge as a condition of supplying gas to any person; or

(*b*) make a minimum charge or service charge to any person supplied with gas by such company.

It will thus be seen that in New South Wales the way is clear for a thorough consideration of their position by various companies.

Although statutory restrictions have in the past prevented development in New South Wales and may have operated in other States, and though there may have been other considerations surrounding individual cases, there is also one other feature regarding the question of rates which forcibly impresses itself upon one interested in the subject. That feature is the absence of any co-ordinated effort to study the subject.

In view of the fact that this is the first time the Institute has made the question of Gas Rates a subject for definite discussion, it is felt that a broad survey of the various matters involved will serve the greatest immediate use.

The inequitableness of the straight line rate between customers is brought out by an analysis of my Company's customers' accounts over one quarter.

The average quarterly quantity used was 5833 c.ft., and approximately 62·86% of the customers used less than this quantity and were consequently, to varying degrees, carried by the remaining 37·14% of customers. If data for gas are taken in conjunction with those for customers, it will be seen that customers who used over the average quantity—*i.e.*, 37·14%—used 59·34% of the total gas. These data very clearly illustrate how necessary and urgent is the need for some other form of charging than the straight line rate.

In order to construct a rate that will assess to each individual customer his just share of the total cost of carrying on the business, it is necessary to resolve this total cost by analysis and allocation into elements having direct reference to each customer's peculiar use of the service.

The total cost of carrying on business may be divided as follows:

1. Interest on capital invested—*i.e.*, the cost of the money required to provide the facilities for doing business.
2. Depreciation—*i.e.*, the amount that it is necessary to provide for maintaining the original investment.
3. Operation—*i.e.*, the cost of producing and distributing the gas and the cost of all incidental service to customers.

However, this division of the total cost does not reflect the exact responsibility of each individual customer.

Further analysis and allocation are necessary to provide the method of determining the costs involved in each customer's peculiar demand on, and use of, the service.

Since the capital invested in manufacturing plant is fixed by the total of the demand of all customers on the maximum day it is evident that capital charges on the amount invested in manufacturing plant should be assigned to each customer in proportion to his individual maximum daily demand. Also, since part of the investment in the distribution system is fixed by the total of the demands of all the customers in the maximum hour, it follows that capital charges on this part of the distribution system should be assigned to each customer in proportion to his individual maximum hourly demand.

This disposes of capital charges on the value of property. Depreciation charges may for convenience be dealt with in the same manner as capital charges.

It is obvious that the charges for interest and depreciation accrue independently of the volume of gas used by customers; and as they have been incurred in providing for the needs of the community it is only fair that individuals requiring service should bear these expenses in proportion to their demand.

Apart from interest and depreciation charges there are to be considered the costs of operation, which are incurred in direct proportion to the volume of gas used by each customer. In addition to those operating costs which vary

* From a paper before the Australian Gas Institute.

with the quantity of gas made, there are other operating costs such as meter reading, account keeping, &c., which are incurred by the company through customers, independent of their hourly or daily demands and independent of the total quantity of gas consumed.

Since these costs are not dependent upon any other feature than the total number of customers supplied, they should be distributed among all customers in equal shares. Thus it will be seen that there are four different groups of costs involved in service which it is necessary to consider in constructing a rate if each customer is to pay his just share of the total cost. In other words the cost of gas service is made up of four elements:

1. Production demand costs.
2. Distribution demand costs.
3. Customer costs.
4. Commodity.

These groups of costs have definite and varied characteristics, and each one must be referred to a definite unit of the service rendered.

These units will, of course, depend on the manner in which gas is sold—*i.e.*, by heat units or cubic feet—but the following may be taken as an example. The unit of service covered by the production demand is the readiness to produce 100 c.ft. of gas in one day. The unit for the distribution demand is the readiness to deliver 100 c.ft. of gas in one hour. The unit for the customer costs is each customer himself, and the unit for the commodity is 1000 c.ft. of gas as measured by the customer's meter. These quantities are arbitrary and may be altered for convenience.

Flat Meter Rate.

The flat meter rate is the oldest and simplest form of rate. The main objection to this type of rate is that each customer does not bear his fair share of gas service unless it happens that all the customers of a company have approximately the same demand or use the same quantity of gas.

In actual practice the operation of this rate means that a small number of consumers with consumptions above the average and with good load factors meet the losses incurred by supplying the greater number of customers with consumptions lower than the average and with poor load factors. The rate has many other disadvantages which will be obvious on reflection.

Flat Meter Rate with Service Charge.

The first change from the flat meter rate in American practice was the addition of a meter or service charge which ensured the company a certain minimum income per customer regardless of whether the customer used gas or not and regardless of the quantity used. This service charge is similar to the customer charge of the theoretical three-part rate.

Step Rate.

Under a rate of this style it is customary to charge all gas at the price for the group within which consumption may fall, and this has the grave disadvantage of enabling consumers to pay less for larger quantities of gas than would have been paid for small quantities. The rate has another disadvantage when considered from the viewpoint of rate of demand.

The rate is also unfair as between customers, for while it is true that there are certain customers whose large use of gas is the result of many hours' and many days' use at relatively low demand rates, there are other customers who use large volumes of gas, but use it in a limited number of hours and days. This latter class of customer is not entitled to reduced rates for large quantities of gas, because the fixed charges on the production and distribution equipment assigned to their use are necessarily high in proportion to the quantity of gas used. This latter objection to the rate on the ground that it does not take cognizance of the demand is, however, secondary in importance to the objection first mentioned—viz., that it enables the total charged for a large quantity of gas to be less than the total charged for a smaller quantity of gas.

Block Rate.

This rate avoids the most objectionable feature of the step rate, inasmuch as quantities are sold in blocks at a set price for consumption in each block. The rate, while an improvement on the step rate, does not take into account differences in demand between customers.

Block Rate with Small Initial Step as a Minimum Bill.

This rate is an improvement on the ordinary block rate described above, embodying as it does a provision for a minimum return. The rate, however, like the one above, gives no consideration to the question of differences in demand between customers.

It approximately, however, takes care of the customer charge. That is to say, the small initial quantity ensures that every customer shall pay a certain minimum amount monthly regardless of his further use of gas.

The block rate with service charge is another variation of the block rate and provides for an undisguised service charge.

Demand Rate.

This rate consists of two charges, a demand charge and a commodity charge, the former being based on the customer's hourly demand and the latter on the quantity of gas consumed. This rate takes into account the hourly load factor of the different customers, but does not give consideration to the costs that vary with the 24 hours' demand, and to this extent varies from the theoretical rate. Nor does it take into account the customer cost, although for large customers this item is not important.

Three Part Rate.

This rate includes, in addition to the demand and commodity features of the demand rate given above, a customer charge designed to cover those costs which vary with the number of customers served.

In Great Britain suggested forms put forward by the National Gas Council in 1930 for domestic customers consisted of (*a*) a two part tariff providing for a service charge and commodity charge, (*b*) a block rate with a minimum charge, and (*c*) a block rate without a minimum charge.

In the United States, where rates other than the straight line rate are extensively used, much favour appears to have been bestowed on the simple block rate, as far as domestic service is concerned, although there appears to be a growing use for the block rate with a small initial block constituting a minimum bill.

An idea of the forms of rates which are in use in Australia may be gained from the data collected by my Company concerning those used by thirteen undertakings in the Commonwealth. The methods employed by these companies are as follow:

Undertaking	Application of Rate.	Nature of Rate
A. . .	General . .	Straight line
	Industrial . .	Scale of discounts practically converting straight line general rate to step rate
	Hot Water. .	25% Discount in general rate—a straight line rate
B. . .	General . .	Straight line
	Industrial . .	Scale of discounts practically converting straight line general rate to step rate
	Hot Water .	Straight line
C. . .	General . .	Two rates of discount—practically step rate
	Commercial .	Discount on all gas if consumption over fixed quantity—practically step rate
D. . .	General . .	Block rate, with service charge based on size of meter
E. . .	General . .	Scale of discounts subject to payment within specified time—practically step rate
F. . .	General . .	Discount subject to payment within specified time, with additional discounts for large consumption—substantially step rate
G. . .	General . .	Discount subject to payment within specified time, with additional discounts for large consumption—substantially step rate
H. . .	General . .	Step rate
I. . .	General . .	Varying rebates paid in cash according to total consumption—substantially step rate
	Special . . .	General rate, *plus* 1s. per 1000 c.ft special discount
J. . .	General . .	Straight line, with discount of 5% where value of annual quantity exceeds £100
	Industrial . .	Scale of discounts based on general rate—substantially step rate. 10% discount for cash in 21 days
K . .	General . .	Scale of discount—substantially step rate
L. . .	General . .	Step rate
M. . .	General . .	Scale of discounts subject to payment within specified time

From this list it will initially be seen that with one exception either straight lines are used in their crude form or else transformed into what are virtually step rates by the use of scales of discounts.

Another feature which particularly obtrudes itself is the continual association of prompt payment with entitlement to the benefits of rebates.

There are a number of grounds upon which the data set out in the table may be criticized, but it is not proposed to go into these in this paper.

The rates, however, conform neither to practice in the United States nor to what has been indicated as desirable practice in Great Britain, and one cannot but be struck by the fact that, while in the one country that has had the scope to develop the question step rates have been practically discarded, in Australia we appear bent on developing the step rate.

Before passing from the data given in the table it is

worth remarking that Company " D " is a combined gas and electricity company.

The fundamental principles of sound ratemaking are well established. " They are, first, reasonable earnings; secondly, promotion of business; thirdly, no unjust discrimination." Unless these fundamentals receive proper and full consideration before action is taken, they will not do justice to either customers or company.

One of the first considerations of practical ratemaking is the ascertainment of unit costs, and the actual rates put into force may bear little resemblance to the theoretical rate established by an analysis of costs. This fact, however, does not render cost analysis any less necessary, for it is laid down that the primary object of rates is to secure a more equitable distribution of costs; and although the first rates put into force may not secure an allocation which is completely equitable, they will at least be a step in the right direction.

Rate Structure as a Business Builder*

By A. J. Dobson.

" The determination of a proper charge for gas service is fundamentally the same as the setting of a selling price for a commodity or service in any other business."

Gas Service Needs Salesmanship.

In adopting the foregoing text there is a frank admission that gas supply is no longer a monopoly service. Technically we are the " single seller " of town gas, and statutory rights may prevent direct opposition in that commodity. But our competitors are many and are increasing in numbers each year. We are all alive to the reality of " alternatives to gas " which are available to our present potential customers. Nor can we disregard the intensity of this competition. From electricity the competition is already direct and obvious. There was a time when the price margin in favour of gas gave a substantial advantage to us, but can we still claim that advantage while every day the electrical supply undertakings are adapting and adjusting their price tariffs for the specific purpose of securing some of the heating load now held by gas!

Apart from designing " price " schedules and skilfully planned tariffs, we are aware that progress in the generating of electrical current is showing very marked economy over old-time practice.

Standardization May Retard Progress.

Why is it that " tariff " adjustments have not received more attention? Is it because the Gas Industry believes itself to be in an impregnable position, or is it because of want of vision or, even worse, due to a lethargy that is hanging over us from adherence to obsolete ideas and traditions of a century of progress under conditions now entirely changed? One of the first reasons quoted will no doubt be that we are fettered by Parliaments, but, after all, why should gas be bound down by obsolete Parliamentary regulations while our rivals have been allowed to go practically free from control? Is the Industry altogether free from blame for the continuance of any manifest injustice? Even Acts of Parliament can be amended. Many of the so-called statutory restrictions on our powers of introducing improved rate schedules are on examination found to be more or less imaginary. In fact, numbers of the substantial advances in modernizing of practice have been associated with Parliamentary revisions, and there is no doubt the fear of having foisted on the Industry rules and practices too dreadful to contemplate has often caused gas officials to become active in searching out and recommending wise and progressive changes.

Sales Managers for Everything but Gas Service.

Without wishing to be dogmatic, it may be said that another of the reasons why price tariffs have not received more attention is because fixing the price of gas has come to be regarded as a foundational policy matter. The basis of charging is truly a matter of policy, but if our competitors can afford to have specially skilled officers as " Tariff Engineers," constantly constructing and adjusting their tariffs, surely the large and varied volume of business handled through " gas sales," representing by far the greatest part of every Company's income, justifies the appointment of similar experts in the Gas Industry. In any other business the price of a commodity or service must be fixed in the full knowledge of the exact competition that has to be met, and the numerous gas rates established when the price question is keenly handled shows that a great deal of variety and adaptation is required from a gas company when it is keenly after business.

Experience Teaches.

From America we should take our lesson in this regard, and the amazing development of both natural gas and manufactured gas sales over there shows what can be done by progressive sales programmes.

From the publications of the American Gas Association we get most illuminating summaries of the way in which specialized rate schedules are being amplified to meet the ever-changing conditions in that remarkable country. Take the list set out as at Jan. 1, 1931:

1. General service or domestic rates	1051
2. House heating rates	530
3. Industrial rates	251
4. Commercial rates	58
5. Industrial and commercial (wholesale rates)	165
6. Water heating rates	56
7. Building heating rates	29
8. House heating and industrial rates	11
9. Off-peak industrial and commercial rates	17
10. Special domestic rates	146
	2314

This shows the trend towards variety and adaptation to meet changing and expanding business and combat competition that is without doubt developed from other fuels by specialized pricing.

Correct Pricing for Gas Service is Technical and Intricate.

Just how far each business will need to specialize in its tariffs will obviously depend upon the special circumstances of the sales problems confronting it. Some competition can be met more easily than other, and possibly a degree of margin from good business must be used to combat more intense competition in other classes. But this should be a very restricted margin. We assert that it is fundamentally unsound to expect good customers to carry the burden loaded on to a business through its trading with unprofitable customers. This statement may at first seem to suggest a fixity of rates with very little elasticity, and logically it does create a definite measure whereby prices may be fixed. If the whole business is grouped under one common description then the flat rate operates effectively as a similar fixed measure.

But the business should not be so grouped. It is exactly here that the scientific rate structure and business building programme begins. We also assert that the price which a customer should be asked to pay for gas should be limited to the cost of producing and supplying gas to that customer.

Sell at Cost to Each Customer.

The difference in cost of supplying large industrial as against house consumers is obvious, but the largest proportion of gas sales in Australasia, and generally speaking throughout the Industry, is made to domestic users. One of the five points summarized in my 1928 paper on Rate Structure was therefore " the 'differential' as opposed to the 'flat' rate system of charging for gas indicates a bigger margin of difference in value to the company of relatively small consumers, and the cost of supplying gas and service to domestic consumers is subject to much greater variation than is generally supposed."

A table is set out hereunder showing the application of a two-part tariff to Adelaide. Its effect on the pricing of gas to domestic consumers makes very manifest the difference in value of relatively small consumers.

	Cost per 1000 C.Ft. to Consumers with Monthly Consumption of—			
	400 C.Ft.	2000 C.Ft.	4000 C.Ft.	10,000 C.Ft.
	s. d.	s. d.	s. d.	s. d.
Flat rate at 9s. 4d. per 1000 c.ft.	9 4	9 4	9 4	9 4
Service charge, 6s 4d. per consumer per month—				
Commodity, 5s. 6d. per 1000 c.ft.	23 9	8 8	7 1	6 2

This two-part tariff is scientifically inaccurate, as it fails to take into account the demand cost, which is with-

* From a Paper before the Australian Gas Institute.

out doubt one of the factors involved in making gas supply available on consumers' premises. In allocating the distribution charges to "Service Charge" it does not make an adjustment for some distribution charges to be apportioned as a relationship to the throughput of gas or size of service and meter.

The theoretically correct rate makes these corrections, but I have not been able to find a simple or inexpensive practicable method whereby this adjustment can be made to satisfy the needs of both science and business.

Nor does it seem there is much variation required in the service charge to adjust the demand charge for domestic consumers. Practically the demand charge may be ignored in their case. With large industrial users, of course, the demand variant requires adjusting.

Costs are Not Properly Apportioned in a Per 1000 C.Ft. Charge.

The rates just described were established from analysis of costs three years ago, and although now considerably modified, are still substantially correct for the purposes of the discussion for which they are submitted. They were arrived at as follows.

In the table the production demand is loaded into the commodity charge and the distribution demand and distribution service variation into the service charge.

It is claimed for the apportionments, in spite of their failure to disclose exactly the cost of supply to each individual customer, that they more directly relate the items of expense to the factors that have caused them than does any system which allocates the whole of the expenses on a per 1000 c.ft. basis.

Two Part Tariff.

Analysis of Expenditure.

64,306 Consumers. 1278 Million C.Ft. Gas Sold by Meter.

Operating Costs.

Charge to—	Per 1000 C.Ft.	Amount.	Commodity.	Service Charge.
	s. d.	£	£	£
Gas into holder	5 4·7	345,040	345,040	..
Rates, rents, and taxes	0 2·9	15,595	9,357	6,238
Distribution	1 4·5	87,841	..	87,841
Management	0 5·6	29,769	10,947	18,822
Legal and sundries	0 1·1	5,688	2,844	2,844
Total	7 6·8	483,933	368,188	115,745
Less residuals	1 8·3	108,208	108,208	
	5 10·5	375,725	259,980	
Less s/r profits, &c.	0 1·1	6,216	6,216	
	5 9·4	£369,509	£253,764	£115,745

Commodity charge, per 1000 c.ft. . . . . 3s. 11·6d.
Service charge, per consumer . . . . . 3s. per month

Capital Charges.

Outlay.	Total.	To Commodity.	To Service Charge.
	£	£	£
Works	1,046,883	1,046,883	..
Mains	851,320	..	..
Services	326,153	..	..
Meters	155,633	..	..
Prepayment installations	26,240	..	..
Miscellaneous reticulation	10,123	..	1,369,469
H.O. buildings, &c.	71,535	35,767	35,768
	£2,487,887	£1,082,650	£1,405,237
Dividend and interest, at 7·092%	176,438	76,780	99,658
For special purposes, at 2·024%	50,351	21,911	28,440
Total	£226,789	£98,691	£128,098

Per 1000 c.ft. . . . . 3s. 6·6d.
Commodity charge, per 1000 c.ft. . . . . 1s. 6·5d.
Service charge, per customer. . . . . 3s. 4d. per month

Final Summary.

—	Flat Rate Charge per 1000 C.Ft.	Commodity Charge per 1000 C.Ft.	Two-Part Tariff. Service Charge per Month.
	s. d.	s. d.	s. d.
Operating costs	5 9·4	3 11·6	3 0
Capital charges	3 6·6	1 6·5	3 4
Total.	9 4	5 6·1	6 4

While not altogether conclusive the figures, we again contend, do more nearly reveal the cost of producing and supplying gas for each particular consumer than the methods of estimating where a service charge is not taken into account.

It is really remarkable that the Gas Industry should be so slow in introducing a service charge as part of the charge for gas supply. Other similar utilities, such as telephone and waterworks, make a regular charge, and, moreover, get it paid in advance. The principle is well established in the Commonwealth and State Government accounting, and electric supply undertakings generally have it embodied in their tariffs, either as a direct service charge, minimum charge, meter rent, or other form. And yet the Gas Industry in Australia apparently hesitates to bring it into force.

Would the Change be Profitable?

There will obviously be difficulties and hazards in the introduction of such a scheme of charge, but are we fully aware of the difficulties and hazards we are carrying by reason of our present inequitable tariffs? Take, for instance, the question of extra appliances. Do we seriously think that we can make the gas fire as universally installed as the gas cooker if we ask consumers to pay a price for gas on the same level as that for cooking? There is no doubt the modern gas fire is a wonderfully attractive household "comfort-aid," with its quick response, immediate service, cleanliness, and artistic appeal, but generally the gas tariff makes it an expensive service compared with the wood, coal, or coke alternatives.

Undeveloped Potential Market.

As far as Adelaide is concerned there is still the same tremendous undeveloped field for extra (*i.e.*, additional to stove) domestic appliances. There the full use of bath-heater, copper, and fire would develop a fully using cooker consumer from a 2000 c.ft. per month to a 4000 c.ft. per month consumer, and increase our output of gas on the basis of our peak year by 79%. These extra appliances are thoroughly proved, are attractive, and have been well established as media of gas service. They should be installed as a logical development from "cooker service," but we all know as a fact that this development is of very slow growth. It cannot be emphasized too strongly that by continuing with a scale of charges for gas to these extra appliances on a basis that ignores the "service charge" factor we are double banking on consumers the "service charge" expenses and loading our sales programme with a weight that is both illogical and overburdening.

Servicing a Consumer is a Financial "Load Factor."

Compared with the peak year 1929, in South Australia we have only lost 10% of our consumers, but gas sales are down 30%.

Year to June 30	1929	1932
Active consumers	65,000	58,000
Gas sold	1264 million c ft.	883 million c.ft.

The financial position became as follows:

Cost of Gas.	1929. Per 1000 C.Ft. Sold.	1932. Per 1000 C.Ft. Sold.
	d	d.
Net cost coal	27	24
Other working charges	20	21
Distribution and management	24	27
Total, excluding capital charges	71	72
Margin for capital charges	*41	40
Price of gas	*112	112

* 1932 price.

It will be observed that the cost of gas (excluding capital charges) has been kept down to practically the same unit figure in spite of the reduced output. The margin for capital charges appears the same in both statements, since obviously that margin is the difference between the price and the cost figure mentioned. Actually, of course, the reduced output has caused a falling off in the sum total available for capital charges; the dividend has fallen from 7½% to 4% per annum.

Quantity of Gas Does Not Indicate Value of Service Supplied.

The point it is desired to illustrate, however, is the theory as to the effect of falling revenue when a flat rate system is in operation as against a two-part commodity

price *plus* service charge system. Under the flat rate charge the revenue would be:

1929—1264 million c ft. at 9s. 4d.		£589,866
1932— 883 million c.ft. at 9s. 4d.		412,066
Reduced income		£177,800
Under the two-part system—		
1929—65,000 consumers at service charge of £3 16s. per annum		£247,000
Commodity, 1264 million c.ft. at 5s. 6d.		347,600
		£594,600
1932—58,000 consumers at £3 16s.	£220,400	
Commodity, 883 million c.ft. at 5s. 6d..	242,825	
		463,225
Reduced income		£131,375

The extra fall in revenue under the flat rate charging system is £46,425, that system showing a decrease of 30% as against the other system 22%. Both methods, of course, show a decrease, and the criticism that with a lesser output there would be a decrease should be satisfied by pointing out that any excess or idle works capacity is covered in the "commodity" charge, which practically decreases in exact relationship to the reduced quantity of gas sold.

It will probably be said that with a service charge we would have lost so many extra customers that in the long run it would have brought our revenue down to the same decrease as under the flat rate. No one will deny that the greater the service charge the greater the tendency to cut out the gas service altogether under the stress of financial embarrassment. On the other hand, the quick service and emergency value of gas are almost essential to the modern home, or at any rate it is a convenience and safeguard which people who have been users of gas are very reluctant to give up. Those other utilities where the "service charge" system is in operation did not find it necessary to abandon that method of charge during the recent business depression. After all, a 15s. per month gas bill is only 6d. per day, and a 6s. 4d. per month service charge, although admittedly a high service charge, amounts to only 2½d. per day. The Electricity Commissioners in Victoria have a minimum domestic service charge of 4s. per month, and in Adelaide the Electric Supply Company maintain a minimum charge of 3s. 6d. per month. The recent introduction into New South Wales of charging per "gas unit" is a very promising move towards selling gas on more attractive lines than hitherto. It certainly gives gas a splendid advertising foundation as against electricity, and the unit adopted appears to be a much more effective selling basis than the British therm. Nevertheless the writer contends that establishing a selling unit is quite a different thing from constructing a price tariff, and while the adoption of the gas unit as a selling basis is a most notable achievement, it does not correct the inequalities which are inherent in the flat rate charge to domestic and other consumers.

This paper is read as a straightout plea for the introduction of a service charge into the pricing systems of our Australian Gas Companies. Acts of Parliament, peculiarities of supply, finance and competitive difficulties are all local problems with which each company must deal according to its circumstances.

In Adelaide the problem of price has been subjected to a great deal of investigation. In 1928 the problem was how could we increase the use of extra appliances; to-day the problem is still that *plus* how we can win back and increase the cooking load of our peak year.

In 1929, with the commodity charge at 5s. 6d. per 1000 c.ft., left a margin of 3s. 10d. between that and the selling price of 9s. 4d. Therefore it required a monthly consumption of 1652 c.ft. before the consumer would cover his service charge of 6s. 4d. This meant a gas bill of 15s. 5d. per month.

"Good," "Not so Good," and "Other" Customers.

At that time an analysis of consumers' accounts showed 27% were not using enough gas to cover the service charge, 46% were just paying, and 27% were paying in excess. To introduce a two-part tariff meant that a total charge of £55,438 had to be lifted off the "paying in excess" group and loaded on to the "under-paying" group. It meant that 16,000 consumers would have their monthly bills increased by amounts varying between 2s. 6d. and 5s. 7d., 26,000 would increase 7d., 10,000 unaltered, and 5000 decreased. On a count of heads more would suffer an increase than would get a decrease. This would hardly engender enthusiasm among our consumers. It became the same old marital argument as to who should carry the baby for the sake of domestic peace. Actually the increase in the size of the bill would be inappreciable except to those on the extreme margin and who were manifestly unprofitable under the present flat rate system.

The Company could not afford to sacrifice £55,000 of revenue as a price reduction except at the expense of an already diminished dividend. So the policy had perforce to stand waiting an opportunity.

A proposal was drawn up, but instead of service charge we were (owing to Parliamentary limitations) obliged to keep the figure for this charge down to somewhere about 1s. per month as a meter rent. Even with this small rate it was surprising what an effect could be created on the commodity price of gas. An analysis of active consumers (excluding prepayment) to-day shows:

—	Consumers.	% of Consumers.	% of Gas Sales.
100 c.ft per month or less	1,803	..	..
200–300 ,, ,, ,,	4,401	..	..
400–500 ,, ,, ,,	4,521	..	..
Under 500 c.ft. per month	10,725	20·9	6·3
600–700 ,, ,,	4,691	9·2	4·6
800–900 ,, ,,	5,404	10·6	6·8
	20,820	40·7	17·7
1000– 1,900 ,, ,,	22,197	43·4	40·5
2000– 2,900 ,, ,,	5,751	11·2	18·6
3000– 3,900 ,, ,,	1,287	2·5	6·0
4000–40,000 ,, ,,	1,043	2·0	11·0
Over 40,000 ,, ,,	85	0·2	6·2
	51,183	100·0	100·0

Readjusting the Price Towards "Cost to Supply."

A scheme was prepared:

Reduction in price of gas	883 million c.ft.	
Less prepayment	35 ,, ,,	
	848 million c.ft. at 1s. 4d. =	£56,533
To be covered by—		
1. Rental charge for meters	58,500	
Less for houses empty or service discontinued	7,000	
	51,500 at 12s p a	£30,900
2. Special rebate saved; now covered by above reduction		1,800
3. Contribution from revenue		23,833
		£56,533

If the contribution from revenue, £23,833, was applied as a flat rate reduction it would provide 6·48d. per 1000 c.ft. By simultaneously introducing even a small service charge (*i.e.*, meter rent) it is evident that a very much improved sales programme reduction in price could be announced.

It is not the total of reduction we are trying to alter, but the "effectiveness" of applying a price reduction as a means of building up business.

As far as the consumers are concerned:

2,128	would pay 11d. per month extra
4,401	,, 7d. ,, ,,
4,196	,, 4d. ,, ,,
4,691	,, 1d. ,, ,,
22,197	would get 1s. per month reduction
5,751	,, between 1s. 8d.–2s 4d. reduction
1,287	,, 3s per month reduction
3,500	,, 3s. 8d. per month reduction
3,032	,, more than 3s. 8d. reduction.

Or, summed up, 15,416 consumers (using 100-700 c.ft.) would pay an extra £4000.

35,767 consumers (using over 800 c.ft.) would get a reduction of £28,000.

Effective Price Reductions.

These 15,416 consumers only used 11% of the total gas sold, and therefore the flat rate reduction would have given them £2622, or an average of 3½d. each per month; a considerable number, of course, very much less than 3½d. The writer contends that this kind of price reduction is a sheer waste of opportunity. It is throwing away a business building factor in that all price revisions or reductions should be deliberately designed to promote sales developments.

The writer is aware that adjustment in the fixed charges between consumers can be created by "block rates," "step rates," and "minimum charge" systems, and that even in America the straightout service charge is not so generally adopted as these other methods. This is probably not because of the greater merit of these other systems, but as a result of policy in introducing a charge with which the public are not yet familiar. These step rates, block rates, &c., have to be divided into arbitrary sections, to which the respective rates are applied, and are consequently inequitable by that very fact, whereas with the service charge the grade is constant. Once the public are acquainted with the new method there does not seem any greater opposition than to any other system of charge.

Moreover, it is seldom that an adequate adjustment of the price is made under these other systems. For instance, as was pointed out earlier in the paper, to equalize the service charge between a 1500 c.ft per month consumer

and a 400 c.ft. consumer the relative charge should be 9s. 4d. and 23s. 9d. per 1000 c.ft.; a difference which on the face of it looks preposterous. Hereunder is set out what appears to me as the most developed system of gas price tariff in Australia to meet the variation in the value of relatively small or domestic customers:

Per Month.	Price per 1000 C.Ft.			Scale of Decrease in Price.		
	A.	B.	C.	A.	B.	C.
	s. d.	s. d.	s. d.	d.	d.	d.
Under 800 c.ft.	10 0	..	..	..	..	..
800–1400 ,,	9 7	11 7½	12 0	5	..	..
1500–1900 ,,	9 2	11 3	11 7½	5	4½	4½
2000–2900 ,,	..	10 6	11 3	..	9	4½
3000–4900 ,,	8 9	10 1½	10 10½	5	4½	4½
5000 ,,	8 4	9 9	10 6	5	4½	4½

The above reductions are very liberal when compared with most other tariffs in operation in the Commonwealth, and yet are quite inadequate when considered as a fair apportionment under a two-part tariff. As an alternative to a flat rate charge of 9s. per 1000 c.ft., a service charge (4s. per month) and commodity charge (6s. per 1000 c.ft.) would in a certain undertaking produce the same income. Under such the following scale of decrease to small consumers would operate:

Per Month.	Service Charge.	Commodity.	Total.	Per 1000 C.Ft.	Scale of Decrease in Price per 1000 C.Ft.
	s. d.	s. d.	s. d.	s. d.	s. d.
400 c.ft.	4 0	2 5	6 5	16 0	..
800 ,,	4 0	4 10	8 10	11 0	5 0
1500 ,,	4 0	9 0	13 0	8 8	2 4
2000 ,,	4 0	12 0	16 0	8 0	0 8
3000 ,,	4 0	18 0	22 0	7 4	0 8

and this scale of decrease is obviously out of all proportion to that shown in preceding table.

It is an entirely different conception to visualize the apportionment of customer fixed charge on a customer basis as against the throughput of gas basis. Looked at from a customer basis the return from small consumers is absurdly inadequate under a per 1000 c.ft. charge—viz.:

Per Month.	Monthly Service Charge.	Service Charge. Per 1000 C.Ft.	Under Flat Rate Charge. Per 1000 C.Ft.
	s. d.	s. d.	s. d.
200 c.ft.	4 0	20 0	say 3 0
400 ,,	4 0	10 0	3 0
800 ,,	4 0	5 0	3 0
1500 ,,	4 0	2 8	3 0
2000 ,,	4 0	2 0	3 0
3000 ,,	4 0	1 4	3 0

Another way to visualize the customer charge is to set out the relative amounts which under a flat rate the different-sized consumers are contributing to cover "customer" expenses. Gas at 9s. per 1000 c.ft.:

—	Total Bill.	Commodity at 6s. per 1000 C.Ft.	Balance to Cover Customer Costs.
	s. d.	s. d.	s. d.
200 c.ft.	1 10	1 2	0 8
400 ,,	3 7	2 5	1 2
800 ,,	7 2	4 10	2 4
1500 ,,	13 6	9 0	4 6
3000 ,,	27 0	18 0	9 0

A mere rule-of-thumb estimate is sufficient to show that these amounts do not represent a fair spreading of customer costs to each consumer.

Once the public are acquainted with the new method there does not seem any greater opposition to "service charge" than to any other system of charge.

Lighting-Up Verticals After Repairs*

By H. Smith, Nechells Works, Birmingham Gas Department

Before commencing this description the writer would like to state that the method about to be described differs in some respects from the standard method usually adopted. The change from the original method to the one now in use has been one of gradual evolution, based upon specialized experience with one particular type of setting; and while its description may contain something of interest and perhaps also of value to those concerned with different layouts, it is not suggested that this method either could or should be adopted as standard practice. The description is based upon observations recorded during the last four operations for which the writer was personally responsible.

The settings under consideration are of the Woodall-Duckham Company's design, and are ranges of 28 and 32 retorts (nominal capacity 7 tons per day). Each range is furnished with end producers, each quarter range being served by two producers. The producer gas is delivered to the combustion flues along a main flue built into the side of the setting; similarly the waste gases from each retort discharge into a common waste gas flue leading into the central chimney bay.

In each case the range had been let down cold and patched. The retort patching was confined to the spalling zone, where the patches were from four to six full panel courses, and to the offtake corners, where the patches were from two to three panels wide and ten to fourteen courses deep. In every instance the producers needed much more attention, and, being almost re-lined, contained a considerable bulk of new material. The course adopted was to dry out and warm up the setting at a uniform rate throughout the whole period, our objective being that by the morning on which we were due to light up, the coolest part of the setting—namely, the bottom of the check tile flue, should be at least 270° C., everything above that level being well above that temperature, and all silica work well past the critical stage. The time allotted for the complete operation is five weeks.

Preparatory to laying the drying fires, four drip plates are placed in the step grates, and across these are placed false bars (flats). When arranging these flats it is usual to bridge with small pieces of plate the spaces caused by the centre drip plate racks, to stop the fire falling through. Later, when the fires are dropped on the grate proper, the withdrawal of these plates may prove troublesome; and to obviate this possibility it is now our practice to tack-weld the bridging pieces, on one side only, to the nearest flat. This enables us to withdraw the plates without any difficulty.

On the first day of the operation drying fires are laid in each corner of the grates and built up to a depth of 12 in. to 15 in. at the back, tapering to nothing 2 ft. 6 in. forward. At the same time the producer lids are removed and the CO uptakes closed. The fires are fed through alternate doors every four hours, thus leaving half the fires always bright, and are maintained at the same level for approximately one week, with the intention of drying out the new lining of the producer without carrying unnecessary water vapour forward through the cold setting. During the first three or four days the water vapour is obvious as the products from the fires leave the producer charging holes. By the seventh day all traces of "steam" have ceased and the products are allowed to move forward through the setting. Accordingly the CO uptakes are opened and the producer lids replaced; at the same time the CO tiles are opened and the aperture graduated from 2 in. nearest the producers to 4½ in. or 5 in. nearest the stack. The main dampers are closed to ½ in. and the top inspection sight-holes opened. This allows the products from the fires to dry out the CO main, the CO distribution flues, and the top few courses of the retort setting, while a relatively small quantity only is allowed to pass down the combustion flues. As with the producers, so here the water vapour is obvious, as the products leave the top sight holes, and continue for three or four days.

During this period the depth of the fires is gradually increased, and by the eleventh or twelfth day the fires have reached the useful limit on the false bars. On the twelfth day the fires are dropped on to the grates proper and built up to five plates high at the front and pushed well back. The sight holes above each combustion flue are now closed and the main dampers opened to 2 in.

It will have been observed by those familiar with the standard practice of warming up settings that a distinct

* From a paper before the Midland Junior Gas Association, Birmingham, Jan. 12.

departure has been made from the generally accepted method of having all CO tiles and main dampers fully opened from the first day of firing. The reasons for this departure will be discussed later.

From the time when the top sight holes are closed and all the products caused to descend the combustion flues, a definite method of increasing the temperature is followed. Thermometers are placed in each check tile flue, and the temperature is read at least once every day, a recording thermometer being placed in a central position on each side of the setting. At this juncture the temperature in the check tile flue is usually between 60° C. and 80° C., and to reach the desired minimum of 275° C. in the remaining 23 days a steady increase of 8° to 10° per day is required.

This is achieved by one of two operations: Either the main damper openings are increased or the depth of the fuel bed is increased, the deciding factor being the pressure condition observed at the top sight-holes. By reason of the small initial main damper openings, the products from the fires are delivered to the tops of the combustion flues at a very slight pressure, between 1/100 in. and 2/100 in. W.G. As long as this pressure persists it is certain that a reserve of products is available from the producers, and to bring about an increase in temperature the main dampers are increased very slightly, usually ½ in. The dissipation of this pressure is evidence that the existing fires have reached their useful limit, and in these circumstances, to get an increase, the main dampers are not touched, but an additional drip plate is placed in the grate, thus increasing the depth of the fires by that amount.

Either of these alterations produces an immediate but slight increase in temperature, which continues for approximately another 24 hours, while in addition the latter alteration usually reproduces the pressure condition at the top of the combustion flues.

Our own reasoning in support of this method is based primarily upon a consideration of the human element in producer firing, although other factors are involved.

The Human Element.

It is generally conceded, I think, that however carefully instructions are given, and however much personal attention is given by the staff to the carrying-out of instructions, it is almost impossible to get two workmen to tend slow fires exactly alike; in addition one has to contend with variations in the quality of the coke delivered to the retort house and also with varying weather conditions. Bearing these factors in mind, it has been our practice to carry fires capable of producing, first, warm, and, later, hot products of combustion slightly in excess of the volume required to maintain that steady increase in temperature which is so vital with silica material.

The correct quantity required is controlled by the adjustment of the main dampers and the graduation of the CO tiles, the slight reserve in the producers being sufficient to compensate for, or eliminate, the individual variations of the human element, changes in the quality of the fuel, or varying weather conditions.

Another advantage of this "level gauge" method is the reduced amount of infiltration of cold air through the top and side faces of the setting. However carefully temperatures are raised a certain amount of "lifting" always takes place, and with "pull" conditions considerable quantities of cold air are drawn into the setting at inaccessible places, causing irregularities in temperature over which one has little or no control. With the method described infiltration is largely reduced and in some positions is reversed to a slight outward discharge of warm products. It has been definitely established on these particular settings, when working under distinct "pull" conditions, while warming up, that an appreciable difference in temperature exists between the front and back combustion flues. Owing to the front flue having the prior call on both the products supplied and the pull from the stack, whenever an increase in pull is made, the front flue for a time rises sharply while the back flue drops back. With the level gauge condition, although the velocity of the gases is slower the flooding effect over the five flues produces a more even temperature.

One aspect of the case which might be regarded as a disadvantage, but which from the ideal viewpoint should not be, is the fact that in practice it is impossible to rush the job, due to the stack pull developing rather slowly, and it is only towards the end of the operation that a more rapid rate of increase is possible.

Working on the lines indicated, little difficulty is experienced in maintaining the desired increase. During the first two weeks of this period one of the alterations daily is usually sufficient; towards the end of the operation, however, it is sometimes necessary to increase both the openings of the main dampers and the depth of the fuel bed. From the time when the fires are dropped, firing is increased to every two hours, still through alternate doors. The fires are pricked up every four hours and ashed out once per shift; the top two drip plates being allowed to ash up in order to prevent an excessive rise in the temperature of the producer crowns. A limited supply of water is now supplied to the drip plates, to keep the producer furniture cool. Excessive water only retards the operation, and to guard against this the water supplied to the troughs flows through calibrated nozzles.

Temperatures are then advanced regularly at the prescribed rate by the means already described. Inequalities between individual retorts are levelled up by small adjustments either to the CO tiles or to the main dampers, as indicated by the pressure condition of the individual retort as compared with that obtaining in the section as a whole. Towards the end of the fifth week 90% of the drip plates are in position, the main dampers are from 5 in. to 6 in. open, and the stack pull is from 2½-tenths to 3-tenths W.G.

On the afternoon before lighting up the remaining drip plates are put in position and the fires fed over the clinkering plates for the last few hours, the fuel being pushed well back under the curtain arches with the rake.

The Final Lighting-Up.

Perhaps the easiest way to describe the final lighting up is to give the actual details of the most recent operation. This was timed to commence at 6 a.m. in order that it should be complete early in the day and the setting under observation for several hours before leaving the same evening. All the fires had been cleaned between 3 a.m. and 5 a.m., and the last hand firing made (a supply of dead ashes being reserved for the purpose of sealing up the clinkering plates).

A little before 6 a.m. all thermometers were read, and, the desired minimum being reached, the operation was commenced. The local secondary air slides immediately above each producer lintel were opened 6 in. and the clinkering plates sealed with dead ashes. This immediately threw more pull on the grates and resulted in a greatly increased CO production, the whole of which was burnt by the local secondary air and caused a good colour to develop in the producer lining. This was allowed to continue for half-an-hour to ensure rapid ignition of the cold coke which was then fed in from the top charging hole and left to burn through. Meanwhile the secondary air slides were opened 1 in. and the sight taps on the CO damper box covers opened to introduce further local secondary air to guard against unburnt CO creeping forward.

By this time the fires had burnt through and a trial light-up was made. The local secondary slides were shut and the passage of the producer gas was watched down each section. The first six flues only on each section were lit up, and by this it was judged that hardly sufficient CO was yet being produced. Accordingly the local secondary air slides were re-opened and the fires allowed to develop further. Half-an-hour later the fires were again fed, and the charge pushed well back with the rake and left to burn through. By the end of the second hour (8 a.m.) the last charge was burning briskly and a second trial was made. The local slides were shut and the travel of the gas watched down each section. This time it lit up at every flue but the last, and by slightly reducing the first three CO tiles on each section was made to light up in all the flues. No further alteration of any sort was made until a moderate colour had developed in the CO distribution flues, thus minimizing the chances of losing combustion when subsequently feeding the fires. At 8.45 a.m. the fires were given a generous feed which brought the level of the fuel to just below the curtain arches. The next feed sealed the arches, and at 10.30 a.m. the producers were filled.

The pull on the stack, which was barely ½-tenth W.G. a month previously and had only increased to 2½-tenths W.G. at the commencement of lighting up, now began to increase very rapidly, and the 5 in. or 6 in. opening of the main dampers, necessary during warming up, was checked back to 3 in. Also the quantity of producer gas being made by a clean producer, filled with fresh fuel, was far in excess of that required to bring along the heats gently, and accordingly the primary air slides on the producer doors were checked to 2 in. and blanks placed in the venturies; at the same time the CO tiles were reduced to give a lazy travel of gas along each distribution flue.

The operation was now virtually complete, the time being 11 a.m. and the remainder of the day available to observe progress, the only other alteration made being to close the sight tabs on the CO damper box covers and in turn to open the top sight holes, thus lengthening the CO flame until it just licked down the back combustion flue.

No other changes were made during the day. The heat attendant returned to the plant at 8 p.m. and inspected the heats, and, as these seemed to be coming along a little too

fast, the main damper openings were reduced to 2½ in. and the primary air slides to 1½ in.

Next morning there was just the faintest show of colour in the tops of the retorts.

Table Showing Progress Over the Complete Operation.

Days.	Progress.	Stack Pull. In. W.G.
1	Slow fires laid, producer lids off, CO uptakes shut	*Nil*
7	CO uptakes open, lids re-placed, CO tiles graduated, top sight holes open, main dampers open ½ in.	*Nil*
12	Fires dropped on to step grates, sight holes shut, main dampers open 2 in., secondary air slides cracked	½ tenth
19	Desired increase in temperature produced by gradual increase of depth of fuel bed and main damper openings	1 tenth
25		1½ tenths
30		2 tenths
35	3 a.m. to 5 a.m. Fires cleaned and final hand feed	2½ tenths
	6 a.m. Local secondary air opened, grates sealed.	
	6.30 a.m. Fires fed from top, secondary air open 1 in., also extra local secondary air at CO tiles.	
	7 a.m. First trial light up.	
	7.30 a.m. Fires again fed.	
	8 a.m. Second trial light up, lit up at all points.	
	8.45 a.m. Fires fed to level of local secondary air slides.	3 tenths
	9.30 a.m. Fires fed and curtain arches sealed.	
	10.30 a.m. Producers filled.	
	11 a.m. Main dampers, CO tiles, primary air slides checked back.	
	8 p.m. Final inspection, main dampers and primary air slides checked.	4½ tenths

This method of lighting up has, by the evidence of the results, proved itself effective. Variations frequently have to be employed in certain circumstances, for a range of 28 or 32 7-ton retorts is a large unit, and to meet the seasonal increases of output may have to be lit up half a range at a time.

If one is fortunately placed and given a clear six weeks between the lighting-up of the two halves, the setting is divided into two halves at the central chimney bay by building a feather wall in the waste gas outlets of the latter half. The method as described then serves for the first half, but for the second half it has to be transcribed to suit an initial and constant chimney pull of 5½-tenths or 6-tenths W.G. The most awkward proposition is when the two halves are required within three or four weeks of each other, and it is the necessity of overcoming these difficulties which has been to a great extent responsible for the gradual building up of the method described.

The Chairman (Mr. S. K. Hawthorn) said the lecturer had dealt with what he considered was one of the most vital of gas operations, because any lack of skill in heating-up the retort setting might have very serious consequences, and the life of the setting might be shortened by one or two years. In a large works the responsibility for heating-up a setting rested ultimately with the retort house superintendent; but in order to carry out the whole thing successfully he emphasized the fact that they must have the co-operation of all concerned, including the workmen. He thought that Mr. Smith had given them a model programme for the heating-up of a particular type of setting. For the younger members who, perhaps, had not had any experience of this work, and who might require the knowledge for examinations, he would like to point out that before he gained his experience the whole process seemed a very complicated one of damper adjustments, so he started to learn the adjustments; but, of course, that was all wrong, because they would find that the process was a perfectly logical sequence of operations. Mr. Smith was a little conservative when he spoke of a 10° temperature rise per day. He thought 15° was safe, and he would say that even 20° was safe, if it was regular. This regularity of temperature was of real importance. He thought the period of 35 days was somewhat excessive, and with proper care it could be reduced by seven or ten days. It had been his experience that, during the 24 hours immediately after lighting-up, the setting needed more attention than during the whole process, because during this time the temperature was apt to advance too rapidly and the dampers had to be checked several times.

Mr. J. H. Wainwright (Halesowen) proposed a vote of thanks to the lecturer.

Mr. F. J. Bengough (Nechells Works, Birmingham), who seconded, remarked that the fuel bill was always given as a certain percentage of the coal carbonized; but he thought it would be better if it was given as a cost figure. The fuel figure was governed by the state of the setting, and faulty heating-up would have an effect on the fuel figure throughout its life, and would therefore nullify any improvements which had been incorporated in order to get better results. Mr. Smith had explained the difference between his system of lighting-up retorts and the general practice with pull conditions, used to guard against the risk of explosions in the settings, which might be very serious. He thought Mr. Smith had made a big step for-

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ward in changing over from the pull conditions to the pressure conditions and yet was running no risk.

Mr. A. St. D. Corder (Windsor Street Works, Birmingham) said that it seemed to him that the whole crux of the matter was in the pull or pressure. The idea of the ordinary method of pull was that any producer gas became so diluted that it got beyond the dangerous explosive mixture, and he should imagine that great care must be taken to see that the pressure was maintained, or they might get a more explosive mixture than by working by the old methods.

Mr. W. Macnaughton (Wolverhampton) mentioned the difficulty of getting old and new material to blend, and pointed out that although they might have thermometers all over the setting they did not know what temperature they were getting in the new silica work, and he believed that in lighting-up they did get more spalling in the new work than in the old. His experience was that the longer the soaking period the longer the setting would last.

Mr. C. R. E. Turner (Nechells Works, Birmingham) pointed out that on lighting-up there was a very rapid rise in the heating of the setting, and they could do no end of damage by allowing it to get too hot.

Mr. Bengough said that in Birmingham they had had such good results with downward heating that they did not like to change to upward heating, but they had had spalling.

Mr. A. V. Wainwright (Shrewsbury) remarked that they had an installation of upward heating at Shrewsbury and there had been no spalling whatever.

Mr. H. G. Broadbridge (Leamington Spa) said with upward heating retorts at Leamington they had only had one retort in an installation of 32 which had shown any spalling.

Mr. R. L. Greaves (Wolverhampton) emphasized the benefit which was to be derived from a comparison of the methods of other people. He thought the question of the pressure method would be thought of a great deal by some of them in regard to their next heating-up. The great point they had to consider was the balance between the care of the setting and the fuel used in the heating-up. He was inclined to agree that an increase of 15° to 20° was not too much, provided it was controlled properly, particularly if they were anxious to save fuel. The safeguarding of the setting was essential.

Mr. R. N. Hateley said the alternative method of lighting-up which had been given was very interesting and would require a great deal of thought on the part of those who were in charge of verticals.

Mr. Smith, in his reply, emphasized the necessity of not rushing the job but of doing it carefully. Although there might be some extra fuel used there would be a saving in the extra life of the setting.

In connection with the foregoing paper, Mr. H. Kerr, of the Woodall-Duckham Companies, writes us as follows:

Mr. Smith describes the results of his experience gained on four occasions when it has been necessary to "light-up" one battery setting of Woodall-Duckham vertical retorts, and he is to be congratulated upon the detailed and interesting description which he has given.

The subject chosen must of necessity be of primary interest to every retort house supervisor, particularly those whose daily work brings them into contact with vertical retorts; and in view of our special interest in the subject matter we should like to make one or two comments upon the contents of the paper.

In the introduction to his paper Mr. Smith emphasizes the importance of maintaining uniform control upon a working setting. This cannot be over-emphasized, and any detail, such as the correct logging of temperatures, noting of damper positions, records of chimney pull and producer gas pressure, regular producer fire cleaning, coal throughput, &c., assists in maintaining an efficient carbonizing unit.

The author also discusses the disadvantages of unchecked retort gas leakage. We can confirm his experience that retort leakage can be overcome by correct attention, and that the more efficient working conditions and results usually more than pay for the labour and material involved in the supervision. When retort leakage is observed we suggest that, in addition to checking the retort CO_2 dampers in order to reduce pull in that particular leaky flue, it is also advisable to reduce the coal and the amount of steam passing into the leaky retort, to reduce the internal retort pressure conditions.

It is generally appreciated that the putting to work from cold of a battery of retorts involves considerable care and practice, since the material used in the setting undergoes complex chemical and physical changes during the gradual heating-up.

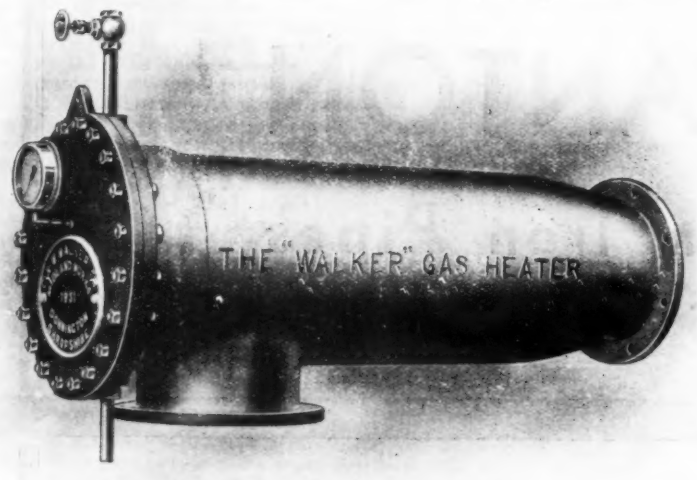
These changes have been described in detail elsewhere,* and in view of their magnitude due precautions must be taken during the putting to work of the setting, since considerable damage can be done which may or may not be immediately apparent.

The process of putting a setting to work can be divided into three portions:

(1) Drying out and warming up.
(2) Lighting-up.
(3) Soaking and putting to work.

The fundamental principles to follow are the maintenance of uniformly advancing temperature conditions within limits,

* W. T. Gardner, Trans. Ceramic Society, XXV., 1925-26.
A. T. Green, Ceramic Society, May, 1932.



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which may vary for each operation, and the complete combustion of the producer gas in the required zone of combustion. This zone also varies with the progress of the operation.

Mr. Smith's description of the final method adopted in lighting-up the setting in which he was interested follows, over the major portion of the routine, that generally adopted by the Woodall-Duckham Company. There are, however, as suggested by Mr. Smith, certain details in the method he describes which it would not be advisable to adopt as standard practice in view of the varied design of vertical retort installations.

In the setting described the major portion of new brickwork was confined to the producers, and the method of venting the producers during the first week, adopted by the author, is to be commended. If the setting had been completely re-constructed, then all the brickwork would be in a "moist" condition, and assuming efficient excess of warm air was allowed to circulate with the products of combustion through the flues it is perfectly safe, and naturally saves time to start the drying out of the retort setting at the same time as the producers.

The contention put forward by Mr. Smith that the usual practice during the warming-up of battery settings is to have all retort CO and CO_2 dampers wide open cannot be accepted, since the important fundamental principle is to maintain as far as possible uniform conditions of temperature, with *very slight* pull to level gauge conditions at the top sight-holes over the whole setting. These conditions should be checked periodically and a record kept of the daily advancement of temperature, together with the details of the vertical expansion of the setting which takes place. Unless the retort CO and CO_2 dampers are correctly graduated and controlled it is difficult to see how these uniform conditions can be even only approximately maintained.

There is no objection during the drying out period to work, as Mr. Smith suggests, with a very slight pressure at the top sight-holes, since the essential feature is to maintain similar conditions at all the sight-holes at any one time. It is agreed that Mr. Smith's method may have slight advantages under certain conditions, but the differences in pressure between the two methods is so small that other differences must, of necessity, be correspondingly negligible and may be upset altogether by the actual position where infiltration occurs.

Even under Mr. Smith's method of heating-up it is difficult to see why differences in temperature should not be observed between the inner and outer combustion flues, since in the type of setting described the outer combustion flues are adjacent to the lateral main CO flue supplying all the hot products, and must receive preferential heating by this arrangement.

The main difference between the routine Mr. Smith describes and that which we usually practise lies in the actual process of lighting-up. His experience gained on one type of setting is interesting and valuable, but, in view of the varied types of retort settings which have been constructed, it is felt that the possibility of producer gas passing unconsumed through the setting during the "trial light-ups" he describes is too great to allow the method to be generally adopted. It would be interesting to have some idea of producer arch and CO main flue temperature just prior to and immediately after closing the "local" 9 in. by 6 in. air slide.

The general practice is to maintain a gradual and uniform increase in temperature during five weeks or so of drying out and warming up of the setting. At the end of that period a uniform temperature of not less than 800° C. is desired in the bottom CO_2 collecting flue. The setting can then be lit-up by gradually proceeding from the commencement of top charging of the producers, through the semi-gaseous condition up to the actual lighting-up, which usually takes from eight to ten hours. The importance of the semi-gaseous condition cannot be overlooked, since, during this period, under correct fire control, which should include making frequent small additions of fuel and careful adjustment of local secondary air, the temperature of the producer brickwork does not become too great and the CO main flue and retort CO nostrils uniformly and gradually advance in temperature until the latter show distinct colour and are capable of maintaining the combustion of the producer gas at the secondary air nostrils immediately following. During the actual period of the semi-gaseous condition and lighting-up it is necessary to keep a slight pull at the top sight-holes and at the CO damper boxes, in order to ensure that all the producer gas is effectively burnt and the waste products are delivered continuously to the chimney.

In Mr. Smith's method, just before lighting-up, the large volume of air admitted at the "local" 9 in. by 6 in. slide might, under certain conditions, result in overheating of the internal producer brickwork, and the actual stage when conditions will permit of the "local" air slides being closed with perfect safety can only be determined after previous experience has been obtained on that particular setting.

The seven days following actual lighting-up are known as the soaking period, and during this period the retort temperatures are very gradually increased to those required for *scurfing* retorts.

In conclusion, we should like to thank Mr. Smith for his interesting paper, which has introduced several points worthy of careful consideration by all interested in vertical retort control.

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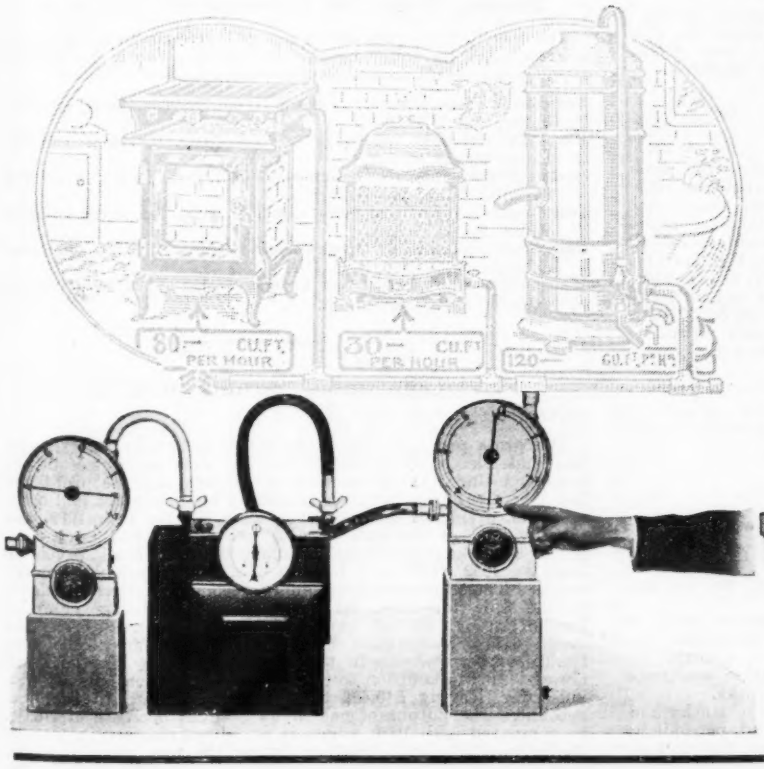

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GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

Business in most markets on the Stock Exchange last week was dull and uninteresting. Prices dropped, though some recovery took place in gilt-edged securities towards the close. A feature of the week was the reversal by the Bank of England of its decision to relax the restrictions on new issues of trustee securities, brought about by the failure of two such issues which had been allowed. Several large industrial issues, however, met with an overwhelming response.

The Gas Stock and Share Market was one of the few bright spots, a large number of transactions being recorded, particularly in Gas Light units and Imperial Continental capital, and both these stocks improved in consequence. Several others continued to harden. Among these, gains of 3 points were recorded by Barnet ordinary to 140-150, Brighton 5% to 130-135, and Uxbridge 5% to 138, while prices generally continued firm.

The Commercial Gas Company is the first of the Metropolitan Companies to announce its dividend. The Directors have recommended a final payment for the past year of 3¼%, making 5¾% for the full year, against 5⅞% for 1931. It will be remembered that during the year the Company made a novel offer to its ordinary stockholders to exchange their holdings for new 5% debenture stock in the proportion of £96 5% debenture stock for £100 ordinary stock, the total amount exchanged not to exceed £350,000. Actually £276,325 ordinary stock has been exchanged for £265,272 5% debenture stock, and the final dividend is payable on the reduced ordinary capital. It is understood that the balance of about £70,000 is still available for exchange.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Jan.* 23.

There are no changes to report in the prices of tar products, which remain as follows:

Pitch is firm at 100s. per ton f.o.b.

Creosote is 3½d. to 5d. per gallon f.o.b., according to specification.

Refined tar is about 4½d. per gallon in bulk at makers' works.

Pure toluole is about 2s. 5d.; pure benzole, about 1s. 11d. to 2s.; solvent naphtha, 95/160, about 1s. 8d.; and 90/140 pyridine bases, 3s. 9d. per gallon naked at makers' works.

Tar Products in the Provinces.

Jan. 23.

The average prices of gas-works products during the week were: Gas-works tar, 34s. to 39s. Pitch—East Coast, 85s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 85s. f.o.b.* Toluole, naked, North, 1s. 10d. to 1s. 11d. Coal-tar crude naphtha, in bulk, North, 6d. to 6½d. Solvent naphtha, naked, North, 1s. 5½d. to 1s. 6d. Heavy naphtha, North, 10½d. to 11d. Creosote, *ex* works, in bulk, North, liquid and salty, 2½d. to 2¾d.; low gravity, 1¼d.; Scotland, 2¼d. to 2¾d. Heavy oils, in bulk, North, 4¾d. to 5¼d. Carbolic acid, 60's, 2s. 2d. to 2s. 3d. Naphthalene, £9 to £10. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o b. In order to arrive at the f.a s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Jan.* 21.

Business remains rather dull in this area, and values are, if anything, easier.

Crude gas-works tar.—The actual value is 45s. to 50s. per ton *ex* works.

Pitch.—Orders are not plentiful, and export value is lower at 87s. 6d. to 90s. per ton f.o.b. Glasgow. Home quotations remain at 95s. to 100s. per ton *ex* works, according to quality.

Refined tar to Ministry of Transport Specification continues to be quoted at 3¾d. to 4d. per gallon naked at works.

Creosote oil.—Prices are irregular owing to large stocks and small demand. B.E.S.A. Specification is 2¾d. to 3¼d. per gallon; low gravity, 2¼d. to 3d. per gallon; and neutral oil, 2¾d. to 3¼d. per gallon—all *ex* works in bulk.

Cresylic acid remains very dull with prices weak. Pale, 97/99%, is 10½d. to 11½d. per gallon; dark, 97/99%, 9½d. to 10½d. per gallon; and pale, 99/100%, 1s. 1½d. to 1s. 2½d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha.—Available supplies command 4½d. to 5d. per gallon f.o.r., according to quantity and quality.

Solvent naphtha.—While there is more inquiry quotations are unchanged at 1s. 2d. to 1s. 3d. per gallon for 90/160 grade, and 11d. to 1s. per gallon for 90/190 grade.

Motor benzole is quietly steady at 1s. 4d. to 1s. 5d. per gallon *ex* works.

Pyridines.—90/160 grade is 2s. 9d. to 3s. per gallon, and 90/140 grade 3s. to 3s. 3d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time.

	s. d.		s. d.	
Crude benzole	0 10½	to	0 11	per gallon at works
Motor ,,	1 6½	,,	1 7	,, ,, ,,
Pure ,,	1 10	,,	1 11	,, ,, ,,

Contracts Advertised To-Day.

Excavating, Laying, and Jointing Gas Mains.

The Borough of Conway Gas Department invite tenders for the above work. [Advert. on p. 219.]

Retorts.

The Loughborough Corporation Gas Department invite tenders for the renewal of retorts. [Advert. on p. 219.]

Tar.

The Directors of the Slough Gas and Coke Company invite tenders for surplus tar. [Advert. on p. 219.]

Metropolitan Gas Companies' Testings.

The Gas Referees' report on the official testings for the past quarter gives the following average calorific values for the gas supplied by the Metropolitan Companies named

Commercial Gas Company.—501·3 B.Th.U. (declared calorific value, 500 B.Th.U.).

Gas Light and Coke Company.—502·5 B.Th.U. (declared calorific value, 500 B.Th.U.).

South Metropolitan Gas Company.—561·6 B.Th.U. (declared calorific value, 560 B.Th.U.).

South Suburban Gas Company.—560·6 B.Th.U. (declared calorific value, 560 B.Th.U.).

Tottenham and District Gas Company.—501 B.Th.U. (declared calorific value, 500 B.Th.U.).

Wandsworth and District Gas Company.—502 B.Th.U. (declared calorific value, 500 B.Th.U.).

Gas Companies' Results in 1932.

Yorktown.

The gross profit of the Yorktown (Camberley) and District Gas and Electricity Company for the year in respect of the combined Undertaking amounts to £20,636, and the profit and loss account shows that after providing for debenture and other interests, dividends on preference stock for the year 1932, and the dividend at the rate of 6¼% per annum less tax at 5s. in the £ on the consolidated ordinary stock for the half-year to June 30, 1932, there is a balance of £13,620 available for dividends. The Directors accordingly recommend that dividends at the following rates be declared for the half-year ended Dec. 31, 1932: 5% per annum on the consolidated preference stock; 6¼% per annum on the consolidated ordinary stock; both less income-tax at 5s. in the £. The ordinary dividend will absorb £3132 in addition to the preference dividend already provided for, leaving £10,488 to be carried forward to the next account. The output of gas shows a slight decrease of 1·65%, as compared with 1931, which is not unsatisfactory in view of the particularly mild weather during the last quarter of the year. Residuals have shown much better results than in the previous year, and the sale of coke has been very satisfactory.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf.-Yr.	Dividends. Last Hf.-Yr.	NAME.	Quotations Jan. 21. (Provincial Exchanges Jan. 20.)	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week
£			% p.a.	% p.a.				
1,551,868	Stk.	Oct. 3	7⅞	7⅞	Alliance & Dublin Ord. ...	105–115	...	113
374,000	"	Jan. 9	4	4	Do. 4 p.c. Deb.	80–96*	...	...
557,655	"	Aug. 22	7	7	Barnet Ord. 7 p.c. ...	140–150	+3	146
300,000	1	Oct. 17	1/9.2	1/4.3	Bombay, Ltd. ...	23/– 25/-	...	24/7½–24/10½
177,750	Stk.	Aug. 22	9	9½	Bournemouth sliding scale	195 205	...	...
550,050	"	"	7	7	Do. 7 p.c. max. ...	150–160	...	156½–157½
439,160	"	"	6	6	Do. 6 p.c. Pref. ...	138–143	...	...
50,000	"	Dec. 19	3	3	Do. 3 p.c. Deb. ...	75–80	...	...
162,025	"	"	4	4	Do. 4 p.c. Deb. ...	98–103	...	...
210,000	"	"	5	5	Do. 5 p.c. Deb. ...	120–125	...	...
357,900	"	Aug. 22	7½	7½	Brighton, &c. 6 p.c. Con. ...	143–148	...	...
540,000	"	"	6¾	6¾	Do. 5 p.c. Con. ...	130–135	+3	136 ¾
195,500	"	"	6	6	Do. 6 p.c. B Pref.	135–145	...	...
1,287,500	"	Aug. 8	5	5	Bristol 5 p.c. max.	110½–111½	...	...
120,420	"	Dec. 19	4	4	Do. 1st 4 p.c. Deb. ...	96–98a	...	...
217,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	95–97a	...	...
328,790	"	"	5	5	Do. 5 p.c. Deb.	115–120a	...	...
885,000	"	Oct. 3	8	7	British Ord.	142–147	...	145½–147
100,000	"	Dec. 19	7	7	Do. 7 p.c. Pref.	140–150	...	...
350,000	"	"	—	5½	Do. 5½ p.c. Pref. ...	105–110	...	...
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ...	90–95	...	...
450,000	"	"	5	5	Do. 5 p.c. Red. Deb. ...	105–115	...	...
160,000	"	Jan. 9	5	5	Cambridge 5 p.c. Deb. ...	117–122*	...	...
100,000	10	Dec. 5	6	6	Cape Town, Ltd.	7½–8½	...	...
100,000	10	Nov. 7	4½	4½	Do. 4½ p.c. Pref. ...	6–7	...	...
150,000	Stk.	Dec. 19	4½	4½	Do. 4½ p.c. Deb. ...	88–98	...	–
626,860	"	Aug. 8	6	6	Cardiff Con. Ord.	110–115	...	...
237,860	"	Jan. 9	2½	5	Do. 5 p.c. Red. Deb.	105–110*	...	...
157,150	"	Aug. 8	6½	5	Chester 5 p.c. Ord.	93–98b	...	...
94,936	1	Oct. 17	2/-	2/-	Colombo, Ltd. Ord.... ...	25/– 30/-	...	...
609,204	1	Oct. 17	/10'90	/11'47	Colonial Gas Assn. Ltd. Ord.	16/– 18/-	...	...
296,053	1	"	1/2'54	1/3'30	Do. 8 p.c. Pref.	19.6 21 6	...	20/6–21/3
1,796,955	Stk.	Aug. 8	5½	5	Commercial Ord.	113–118	...	114–116½
475,000	"	Dec. 19	3	3	Do. 3 p.c. Deb. ...	73–78	...	...
265,272	"	—	—	—	Do. 5 p.c. Deb. ...	117–122	...	...
807,560	"	Aug. 8	7	7	Croydon sliding scale ...	139–144	...	...
469,590	"	"	5	5	Do. max. div.	95–100	...	...
500,000	"	Jan. 9	5	5	Do. 5 p.c. Deb.	117–122*	...	...
542,270	"	Aug. 8	10	7	Derby Con.	150–160c	...	...
55,000	"	Jan. 9	4	4	Do. 4 p.c. Deb.	80–85c*	...	...
209,000	"	Sept. 5	5	5	East Hull Ord. 5 p.c. ...	97–102	...	98¾–98¾
179,500	"	Aug. 22	5½	6	East Surrey Ord. 5 p.c. ...	115–120	...	119–120½
155,019	"	Dec. 19	5	5	Do. 5 p.c. Deb. ...	115–120	...	...
1,002,180	"	Sept. 19	16½	15	European, Ltd.	127–132	+2	129½–133
19,373,992	"	Aug. 8	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	24/9–25/9/	+/3	24/9½–25/5½
2,600,000	"	"	3½	3½	Do. 3½ p.c. max. ...	80–85	...	82½–85
4,477,106	"	"	4	4	Do. 4 p.c. Con. Pref. ...	99–102	+1	100–101
6,102,497	"	Dec. 19	3	3	Do. 3 p.c. Con. Deb. ...	75–79	–2	75½–79
3,642,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	113–116	...	...
3,500,000	"	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	109–112	...	110½–111½
264,011	"	Aug. 22	—	6	Harrogate New Cons. ...	110–115	...	...
82,500	"	Aug. 22	7	7	Hastings & St. L. 5 p.c. Conv.	130 140	...	...
258,740	"	"	5½	5½	Do. 3½ p.c. Conv.	102–107	...	...
70,000	10	Oct. 17	†10	†10	Hongkong & China, Ltd. ...	9½–10½	...	...
213,200	Stk.	Aug. 22	6	6	Hornsey Con. 3½ p.c. ...	117–122	...	...
5,600,000	"	Nov. 21	14	10	Imperial Continental Cap.	202 212	+2	206½–209
223,130	"	Aug. 8	3½	3½	Do. 3½ p.c. Red. Deb.	90–95	...	...
235,242	"	Aug. 8	8½	8½	Lea Bridge 5 p.c. Ord. ...	152–162	...	160–163
2,145,907	"	Aug. 22	6	6	Liverpool 5 p.c. Ord. ...	122–124b	+1	...
245,500	"	Dec. 19	5	5	Do. 5 p.c. Red. Pref. ...	100–110b	...	...
306,083	"	Jan. 19	4	4	Do. 4 p.c. Deb. ...	99–101*b	–1	...
165,736	"	Sept. 5	10	8	Maidstone 5 p.c. Cap. ...	160–170	...	...
56,176	"	Dec. 19	3	3	Do. 3 p.c. Deb. ...	68–73	...	...
75,000	5	Dec. 5	†10	†10	Malta & Mediterranean ...	7½–8½	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	98–103	...	...
171,978	Stk.	Sept. 5	5	5	M. S. Utility "C." Cons. ...	100–105	...	...
718,657	"	"	4	4	Do. 4 p.c. Cons. Pref.	90–95	...	91¾
112,126	"	Jan 9	4	4	Do. 4 p.c. Deb. ...	95–100*	...	97A
148,955	"	"	5	5	Do. 5 p.c. Deb. ...	115–120*	...	...
675,000	"	21 May '31	16	16	Montevideo, Ltd.	35–45	...	31–41
2,061,315	"	Aug. 8	5½	5	Newcastle & Gateshead Con.	23/–24/-d	...	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	95–97d	...	...
691,705	"	Jan. 9	3½	3½	Do. 3½ p.c. Deb. ...	89–91d*	...	...
277,285	"	Nov. 7	5	5	Do. 5 p.c. Deb. '43...	103–107d	...	...
274,000	"	Aug. 8	5	5	Newport (Mon.) 5 p.c. max.	95–98e	+1½	...
199,940	"	Aug. 22	7½	7½	North Middlesex 5 p.c. Con.	135–145	...	...
396,160	"	Aug. 8	5	5	Northampton 5 p.c. max. ...	100–105	...	...
300,000	"	Dec. 5	7	9	Oriental, Ltd.	112–117	...	...
205,162	"	Dec. 19	8	8	Plym'th & Stonehouse 5 p.c.	140–150	...	...
504,416	"	Aug. 22	8	8	Portsm'th Con. Stk. 4 p.c. Std.	150–160	...	...
241,446	"	"	5	5	Do. 5 p.c. max. ...	97–102	...	100½
114,000	"	Aug. 8	5	5	Preston 5 p.c. Pref.	105–110	...	...
686,312	"	July 18	4	4	Primitiva 4 p.c. Rd. Db. 1911	77–82	...	...
389,813	"	Dec. 19	4	4	Do. 4 p.c. Cons. Deb.	75–80	...	...
150,000	10	Sept. 19	6	6	San Paulo 6 p.c. Pref. ...	6¾–7½	...	...
1,736,968	Stk.	Sept. 5	6	6	Sheffield Cons.	114–116e	...	...
95,000	"	Jan. 9	4	4	Do. 4 p.c. Deb.	91–95e*	...	...
133,201	"	Sept. 5	5	8½	Shrewsbury 5 p.c. Ord. ...	118–123	...	...
90,000	10	June 6	15	15	South African	4–6	...	...
6,709,895	Stk.	Aug. 8	7	5	South Met. Ord.	123–128	...	125–127
1,135,812	"	"	6	6	Do. 6 p.c. Irred. Pf.	138–143	...	141½
1,895,445	"	Jan. 9	3	3	Do. 3 p.c. Deb. ...	77–80*	...	77½
1,000,000	"	July 18	4	5	Do. 5 p.c. Red. Deb.	110–115	...	113½–114
91,500	"	Aug. 8	8½	8½	South Shields Con.	150–155d	...	...
1,543,795	"	Aug. 8	6	6	South Suburban Ord. 5 p.c.	121–126	...	122–125
300,000	"	"	5	5	Do. 5 p.c. Pref.	112–117	–3	1124–117
668,837	"	Dec 19	5	5	Do. 5 p.c. Deb.	120–125	...	12)–123
647,740	"	Aug. 22	5	5	Southampt'n Ord. 5 p.c. max.	102–107	...	...
121,275	"	Dec. 19	4	4	Do. 4 p.c. Deb.	95–100	...	...
350,000	"	Aug. 8	—	9/-	Swansea 5½ p.c. Red. Pref.	110–114	...	109–112
200,000	"	Dec. 19	6½	6½	Do. 6½ p.c. Red. Deb.	103–108	...	...
1,076,490	"	Aug. 8	6½	6½	Tottenham and District Ord.	131–136	...	134–135
300,000	"	"	5½	5½	Do. 5½ p.c. Pref. ...	120–125	...	122–124
199,005	"	Dec. 19	4	4	Do. 4 p.c. Deb. ...	95–100	...	...
85,701	"	Sept. 19	6	6	Tuscan, Ltd., 6 p.c. Red. Db.	67–72	...	...
346,069	"	Aug. 22	7	7	Uxbridge, &c., 5 p.c. ...	133–143	+3	142
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	110–115	...	112
1,322,220	"	July 4	7	7	Wandsworth Consolidated	140–145	...	143 143½
1,096,373	"	"	5	5	Do. 5 p.c. Pref.	114–119	...	117
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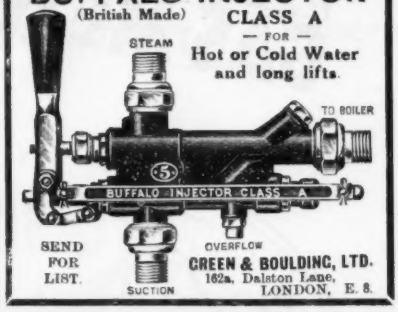

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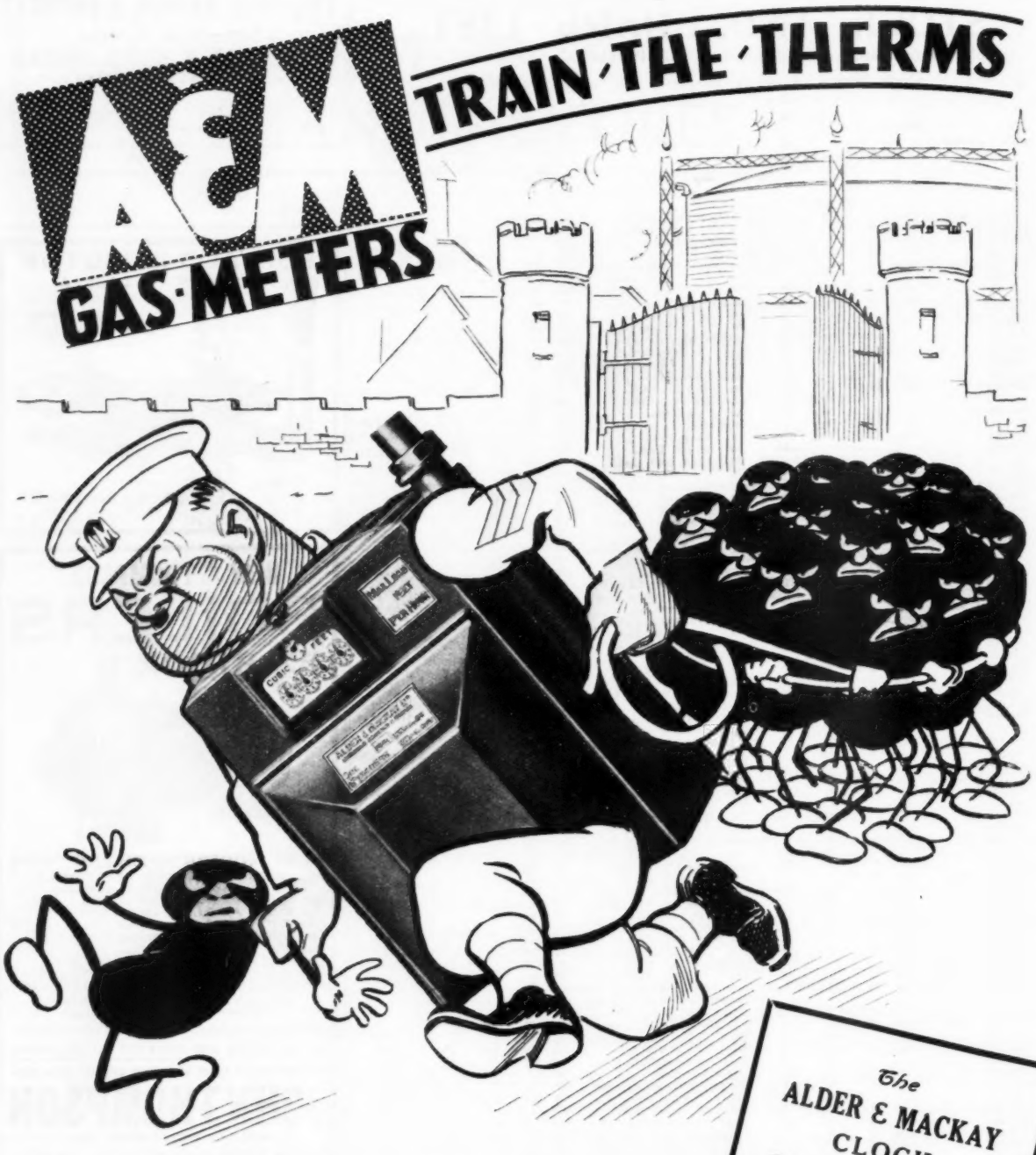

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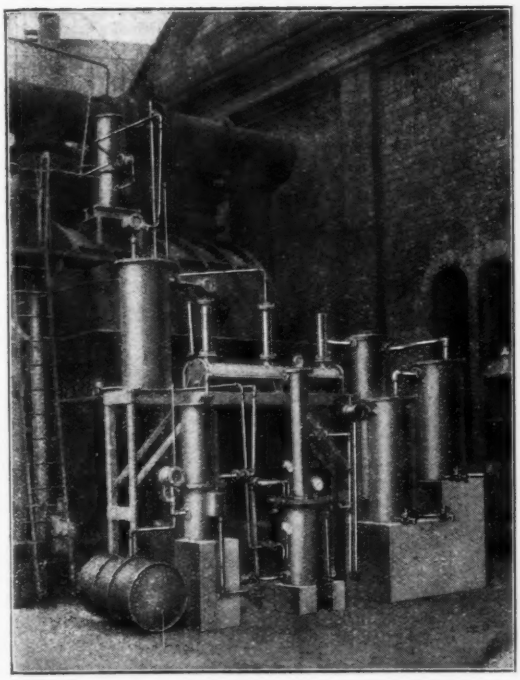

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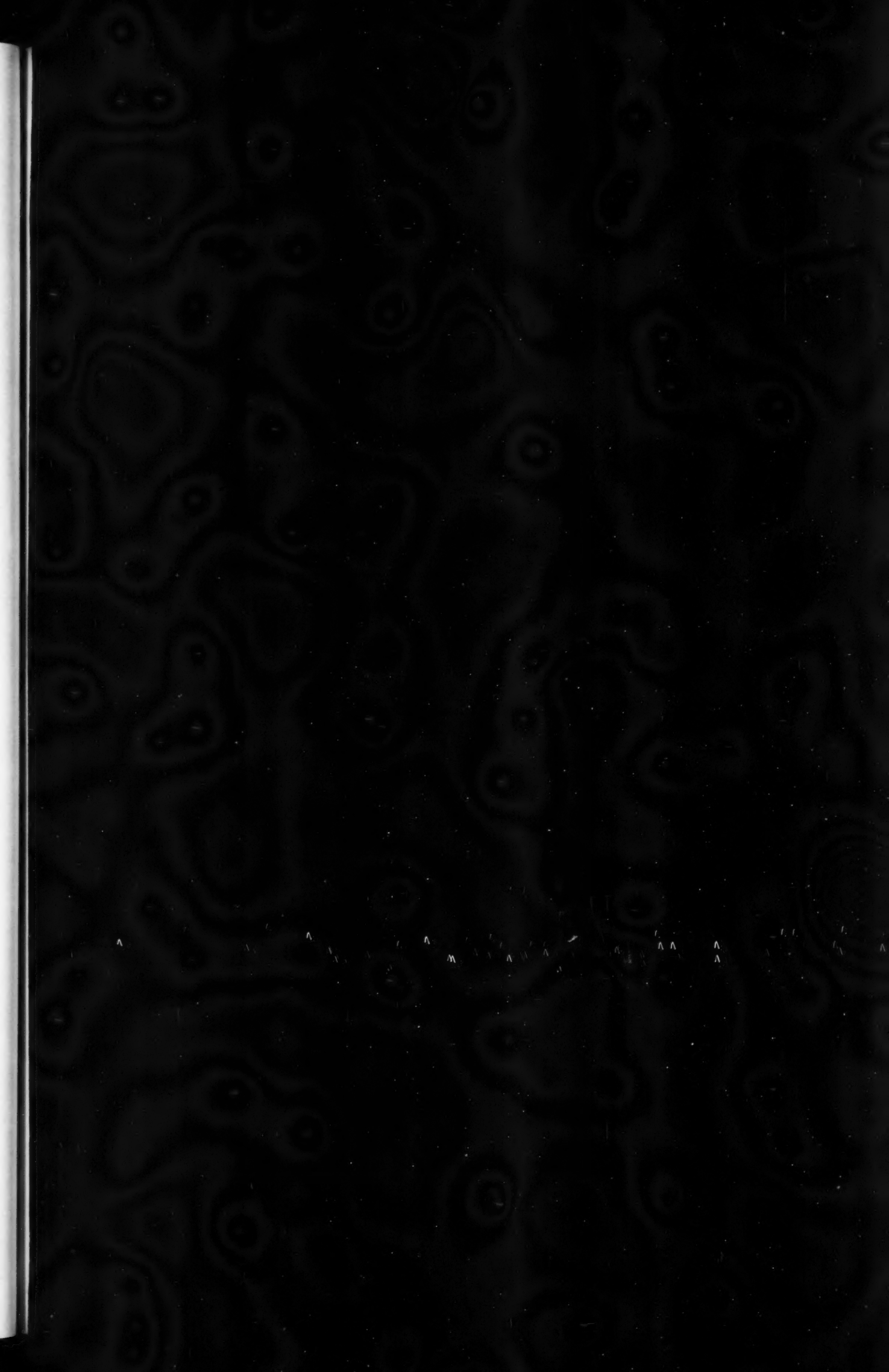
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